# Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

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## Reserve Corps of Engineers

ENGINEERS throughout the country will endorse heartily the action taken at the meeting of the American Society of Civil Engineers last week, in which it was recommended that the proper authorities place the facilities of the society at the disposal of the Federal Government in developing a reserve corps of engineers to be used as required, either in construction of military work or for active service. This journal, during the past six months, has repeatedly urged that engineers recognize their duty and be prepared to aid the Government in case of emergency. Talk of preparedness is in the air, and it is gratifying to note that those in attendance at a regular meeting of the country's leading engineering society unanimously agreed that their organization should be placed at the disposal of the Government. It is to be hoped that there will be no need to call upon such a reserve corps for active service, but our plain duty is to be ready.

## Punishment for Negligence

SPACE did not permit comment two weeks ago upon the successful outcome of the agitation in Pennsylvania to secure a law similar to that in New York, placing responsibility for fires upon those guilty of negligence. The passage of the law was briefly noted on page 631, May 15. It will be remembered that New York City has successfully established the law, and that one company has voluntarily settled for the costs incurred by the fire department in putting out a blaze traceable to neglect of the Fire Prevention Bureau's orders. One must expect that the new Pennsylvania statute will be carried to the courts. It is to be earnestly hoped that it will come through that trial successfully and thus be an encouragement to other commonwealths to enact similar legislation. By passing workmen's compensation acts the tyranny that industry has exercised in the past over individuals has, in that respect, been broken. The fixing of financial responsibility on those guilty of neglect and to whom conflagrations can be traced is but part of the same general movement and must eventually prevail.

## Classifying Engineering Knowledge

HEARTY wishes for success will surely accompany the reading by engineers of the formal announcement of the organization of the Joint Committee on Classification of Technical Literature, which appears in the news pages of this issue. How long and hard the struggle has been to secure a workable yet full classification is evidenced by the number of published efforts to expand the Dewey Decimal System to cover engineering, and by the innumerable private attempts by special libraries and individuals. The questions brought up by the attempt to classify the knowledge in only one branch, say in mechanical engineering, are appalling. When all branches are included, these questions are increased in more than an arithmetical ratio, since the problem of overlaps between different branches comes in. Offsetting the difficulties are the availability of a great number of classifications, forming an excellent basis for consolidation and consideration. But whatever the labor, the end fully justifies it. Manifestly, however, many willing hands and, possibly, support in the way of funds, are needed. For that reason every engineering society of National scope should immediately become affiliated with the movement. This is necessary not only that the committee may have the support it needs, but that the knowledge peculiar to the branches represented by the various National societies will receive adequate and correct treatment in the classification. This is no time to hold back. The good of the profession demands the widest support for the project.

## A Model Report

A WORD of appreciation is due the Bureau of Surveys of Philadelphia for the excellent manner in which the report on the comprehensive plan for the collection and treatment of the city's sewage, which was outlined on page 638 of last week's issue, has been presented. This journal, of late, has made many pleas for the improvement of annual and special reports. The Philadelphia document is a convincing demonstration of what can be done along these lines. It begins with a concise summary of the problem and its solution so that the reader, who is unfamiliar with the project, immediately obtains a clear idea of the work proposed and can, therefore, follow the detailed report with intelligent comprehension. Then follows the main body of the report and at the end are appendices relating to special investigations. By segregating these special studies attention is not diverted from the main issue. The treatment of the matter shows that the Bureau of Surveys has an appreciation of something which most engineers, in their writing, absolutely neglect—the interests of the reader. Many authors of reports assume that what they have to say is so important that they can be as discursive as they like before leading up to the main issue. Long familiarity with the subject on which they have spent years of study makes them assume unconsciously that others have an equally intimate knowledge of the matter, so that when they tell about it they are prone to begin with detailed discussions which leave the reader wholly at sea until he has made progress through page after page of text. Statement of the main issues and general conclusions at the outset cannot be insisted on too strongly, and the Philadelphia report, therefore, although it refers only to sanitary engineering, should have a wide circulation among members of the profession in other branches for it is a good model of the form in which engineering data should be made public.

## New Austin Dam

MERELY because it replaces a structure famous by reason of its deficiency and final failure, the new dam constructed near Austin, Texas, across the Colorado River, would be of interest to engineers. When, however, the building of the structure has required unusual procedure, and the design itself presents a number of novel features, there is reason for giving it a special prominence. The attention of the readers of the Engineering Record, therefore, is directed to the first of a series of three articles, beginning this issue, describing the new dam and its associated hydroelectric plant. The first article tells how foundation difficulties were, so it now appears, successfully overcome. Contrary to advice given since the former dam went out, the engineers of the new project placed the structure on the very site of the old one, making up, however, for foundation deficiency by a thorough grouting of the seamy rock. While this conquering of the foundation difficulties is interesting, this journal believes that the departures in dam design, to be described in the next issue, are of greater importance to the hydraulic engineer. The use of automatic crest gates in order to prevent putting the portions of the previous dam still standing to as great a strain as they have withstood in the past, the design of these gates themselves, the handling of the crest so that they could be properly mounted on a hollow concrete dam, and the placing of sluice gates on the face with their operating cylinders always submerged, are features each sufficient to attract attention to the structure. Those responsible for the new design have shown unusual resourcefulness and courage and are to be congratulated upon the successful event of their labors.

## Roofs and Dust

TO KEEP the pavements clean and leave the far larger area, occupied by the roofs of buildings in the downtown districts of our large cities, cluttered with dirt and rubbish is a practice analagous to that of the small boy who washes his face and leaves his neck dirty. Astonishing, indeed, are the conditions brought to light by the recent investigations of Richard T. Fox, of the Citizens' Street Cleaning Bureau, Chicago, and described on page 683 of this issue. How hopeless it is to try tc keep streets clean when the roofs are constantly furnishing material for the winds to distribute at leisure, to the annoyance of individuals and detriment of everything it touches, may well be imagined. It is surprising that any citizen should condone such a condition and actually fight efforts to clean littered and dirty roofs. And yet it was only by much persuasion and by promising to stand all expenses that the owners of a nearby building, whose tenants had complained of the dirt blown in their windows, were able to remove this nuisance. The action of the Citizens' Street Cleaning Bureau in its efforts to have roofs cleaned by the owners of the buildings or by the bureau deserves hearty commendation. Investigation of the subject in other cities is desirable, and if Chicago's experience is found to be duplicated generally it will be in order to consider ways and means of removing this new addition to the number of disease-causing agents.

## What a Contrast!

WHILE the nations of Europe are at grips in one of the mightiest struggles of the ages, on this side of the water we witness efforts to cement the bonds of international friendship and, by bettering financial and trade relations, further the development of our respective countries. In Washington there started this week a Pan-American Financial Conference, rightly characterized as the most important of Pan-American meetings. The invitation of the United States to discuss ways and means of furthering the interests of the republics of the Western Hemisphere met an enthusiastic reception and no nation remained unrepresented. The outcome cannot at this writing be predicted. We may confidently look, however, for heavier investments by this country in South America, with the inevitable increase in our South American export trade, and for the establishment of "dollar exchange" to replace sterling exchange as rapidly as the inertia of the international banking situation will allow. That we are in a position to proceed to invest in South America cannot be doubted. Frank A. Vanderlip, president of the National City Bank, New York, said on the opening day of the conference that the surplus of the National banks of this country now reaches the enormous total of $736,000,000 and that, on the basis of present reserves, loans can be expanded to $3,000,000,000. The real crux of the situation lies in the ability of South America to go ahead and upon her rate of progress. This is not solely dependent on the amount of investment capital available, but also upon her ability to dispose of her raw and food products and thus establish a basis warranting further development of her resources. Despite this controlling condition, however, there can be no doubt that the Washington conference will redound greatly to the benefit of all of the nations of the Western Hemisphere. Helpfulness and co-operation characterized it, contrasting strikingly with the mania for destruction now obsessing Europe.

## Fire-Prevention Progress

DURING the many interesting discussions at the annual convention of the National Fire Protection Association, week before last, in addition to the significant general advocacy of educational methods for fire prevention and passage of laws providing fines for negligent persons responsible for fire losses, there was apparent an evident desire to increase the rigidity of general requirements by law, and to provide for uniformity in building codes and greater safety in construction. To be sure, it was recognized that excessive requirements might cause opposition, due to excessive cost and resulting injustice, yet it was pointed out that, for example, the saving per year in fire insurance premiums would in a few years pay the cost of automatic sprinklers in mercantile buildings. The need for a campaign of education was emphasized, not only to inform the builders and owners of the wisdom of adequate fire-protection and fire-prevention devices and construction, but to insure the adoption of State building codes which would cover the essential requirements of building regulation, and thus afford protection in small towns and villages. The presence of many building commissioners and inspectors, in addition to prominent members of housing and industrial commissions, gave the discussions a new tone of breadth and significance.

## Sand-Asphalt Roads in Florida

WHILE the Engineering Record always prefers to encourage rather than to throw cold water upon attempts to solve road or any other engineering problems, it is felt that a word of warning should be uttered in regard to the sand-asphalt construction in Florida that was the subject of an article in the issue of May 15, page 622.

The work at Eustis was not laid on a compacted sand base as described by the writer of the article in question, but on a clay base; and we are informed that the sand-asphalt surface is kept constantly covered with an inch of sand to protect it. The work at Dade City is described as a complete failure. This, however, may be explained by the fact that the sand-asphalt mixture was mixed by hand on boards. At Tarpon Springs the grass is growing through the sand-asphalt pavement. At Sarasota the pavement of this description is shoving. The sand-asphalt pavement at Mount Dora was laid in April and its short life hardly permits of any inferences as to what it will do.

The author's statement that a considerable mileage is "now under construction and more is in contemplation," the Engineering Record is informed, is somewhat misleading, although it is true that two counties have voted considerable sums for sand-asphalt construction. This has been done by reason of the encouragement afforded from the Eustis experiment; but the fact should be again emphasized that the latter pavement is not laid on a sand base as has been done and is proposed elsewhere, but upon a stable clay base. While a sand base may be satisfactory for a pavement of types such as is represented by grouted brick, as is argued by Mr. Blair in the letter on page 691 of this issue, we should hesitate to approve it for types such as the sand-asphalt road. If, therefore, sand-asphalt roads have "an excellent opportunity to achieve a high distinction," the opportunity is based upon hopefulness rather than demonstration; and all that we know about sheet asphalt construction and the absolute necessity in connection therewith of the most stable foundation, should lead us to doubt the future of sand-asphalt roads as built in Florida.

## Engineering Wit in the War

WHEN the history of the European war is written in engineering detail, as it sometime must be, there will be no more fascinating chapters than those describing the expedients by which technical experts on one side and the other surmounted difficulties in the field. We shall find, for example, that along with hair-breadth escapes of aviators from capture went quick-witted methods of adjustment and even minor repairs schemed out by clever minds under unprecedented stress of circumstances. There will be stories of home-made electrical devices which took the place of factory products injured or perhaps destroyed by gun-fire or overload continued beyond previous experience, and there will be papers on the construction of trenches and temporary fortifications in the face of fearful obstacles, which will interest engineers of diverse persuasions for years after the great conflict ends.

Even the casual reader of current newspapers and magazines is coming to appreciate in some faint measure the part which organized equipment and technical preparation are playing in the war. The personal experiences penned by the few observers who have been permitted to visit the firing lines bear frequent witness to the coldly scientific methods used. All of the resources of physics, chemistry and mechanics are being summoned to battle as the struggle increases in intensity. The story of the failures of air-craft, of the enormous peak loads carried by the railroad networks of central Europe, of the defects remedied in torpedo-boat motive power and in the auxiliary apparatus of submarines—these and many other topics of engrossing interest await discussion by the engineering world of the future, though they are barred from us in the main today. The history of the motor-truck in the first rush toward Paris will some day be written by engineers competent to interpret the lessons of that service under the conditions then prevailing, and the experience of radio engineers afloat will add still another chapter to the record of the greatest test ever imposed on many of the most notable devices applied science has to this day produced. Deplorable as the war is, it is testing the work of the engineer in a way which will be turned to account in the arts of peace in the years to come.

## Right Attitude Toward the Contractor

RELATIONS between the engineer, his inspector and the contractor have been steadily improving, to the distinct benefit both of the parties concerned and of the public. Between large organizations, such as the railroads and those who do their contract work, the practice of fair dealing dates far back. Small organizations, however, are still, on the whole, suspicious of each other. A paper appearing in a recent issue of "Illinois Highways," written by one of the engineers of the Illinois Highway Commission, H. B. Bushnell, presents forcibly the attitude of the engineer toward the contractor. It reiterates some of the points on which this journal has repeatedly laid strong emphasis.

"The high-grade and honest contractor," Mr. Bushnell says, "is entitled to, and appreciates the benefit of, a good set of plans and specifications. It enables him to bid in an intelligent manner and with the knowledge that all his competitors are bidding on the same class of work. In dealing with the dishonest contractor, definite and complete specifications are absolutely a necessity. Unfortunately for contractors as a whole, a small percentage of dishonest men have wedged their way into this line of business. . . . The writer has found that the most satisfactory way to deal with contractors is to assume that they are honest until they prove themselves otherwise. Do not go on to a job with a chip on your shoulder. Nearly every man has a certain sense of pride in his work, which you can absolutely kill by a domineering and fault-finding attitude.

"It is regrettable, but I suppose unavoidable, that the average graduate from our technical schools has very little conception of the relations between the inspector and the contractor." And as an example of the attitude of the young inspector, Mr. Bushnell says that if the centering upon which a concrete bridge was being built were known to be weak, the inspector, instead of calling the contractor's attention to the matter, would in many cases allow the construction to continue with the determination of condemning the structure and ordering it torn down if it should sag. Mr. Bushnell goes on to say that advice and help from the engineer on matters of this kind are appreciated by the contractor and are reflected in a better quality of work. He further believes that when the contractor and the inspector have disagreed over a point on which the inspector may be technically right but which would impose unreasonable restrictions, it should be possible to adjust the differences without discrediting the inspector or injuring the contractor, provided the latter takes up the matter in a spirit of friendliness. He points out, however, that, if the contractor make the dispute personal, it is necessary to back up the inspector, unless he be clearly in the wrong. "As a general rule," he concludes, "the less friction, the better the quality of the finished work, which is the ultimate aim of any kind of supervision."

Contractors as a class have worked for a better understanding from compulsion, because the engineer has always held the upper hand. Such a plain statement of the case, however, as Mr. Bushnell's, coming from the other side, is but confirmatory evidence that the day of better relations between engineer and contractor, even on smaller work, is at hand.

## Standard Terminology for Filter and Concrete Sands

THE PROPOSAL to analyze sands for all purposes according to one standard and to report the results in a much simpler form than has been done heretofore by waterworks specialists will meet with the approval of those interested in getting well-graded material for concrete as well as of those concerned in obtaining a properly sized filtering medium. Filters must hold water and a graded aggregate helps materially to that end.

A working basis for bringing about the desired uniformity of procedure was proposed at the meeting of the American Waterworks Association in a paper abstracted on page 644 in last week's issue of this journal. Unless the filtration engineer looks at it in a broad light, the proposal to give up his mystical arbitrary terms, "effective size" and "uniformity coefficient," will seem to be a backward step, but the new plan is so simple and should be so readily understood by the men who handle sand for all purposes that the concessions should be made gladly. Moreover, a vast amount of information relative to sizes of sands in different parts of the country is now locked up to the concrete user simply because of the arbitrary terms in which the results are expressed. Fortunately, the author of the paper has made public some factors by which those analyses can be made available for concrete work. The factors represent an enormous amount of work carried out at the Spring Garden Testing Station, Philadelphia, a dozen years ago, but, like reports of many other valuable researches carried out at that station, have never been put into shape for general use.

Allen Hazen, father of the present method of determining sand sizes, concurred in Mr. Burgess' suggestions to a certain extent only. He does not believe in changing the standard from sand grain to sieve opening because he feels that sieves of the same size and number of meshes vary so much in size of opening. This is true and Mr. Burgess recognizes that fact, but it does not alter the argument in favor of expressing results in terms which can better be understood by the sand man, provided sieves can be standardized and can be purchased.

With reference to the terms by which filter sands have been called for, Mr. Hazen's contentions are perfectly proper so far as a medium for slow-sand filters are concerned, but for rapid filters there has long been a feeling that undue emphasis has been placed on the 10 per cent limit represented by the term "effective size." It is the fine material that causes the trouble and about which so little is known, largely because of the prominence given to this single point on the sand curve. "Uniformity coefficient" as a term emphasizes another single point on the curve. Furthermore, material for the Albany and the Pittsburgh slow-sand plants was not called for in accordance with both the 10 and 60-per cent points.

The waterworks association's committee on standard methods of sand analysis should confer with the Bureau of Standards and with the American Concrete Institute's committee on aggregates at the earliest possible date. The Bureau of Standard sieves should be adopted by the several National societies as standard, and after due consultation with all interests affected a definite procedure laid out. With this done, the results of the efforts of the American Concrete Institute and other bodies to have concrete aggregates throughout the country examined will also be available to the waterworks man. He can contribute to the cause by translating his results into the common terms. As an example of the possibilities this co-operation will open up, it may be noted that several hundred analyses of sand from all available sources near San Francisco have been made for filtration purposes.

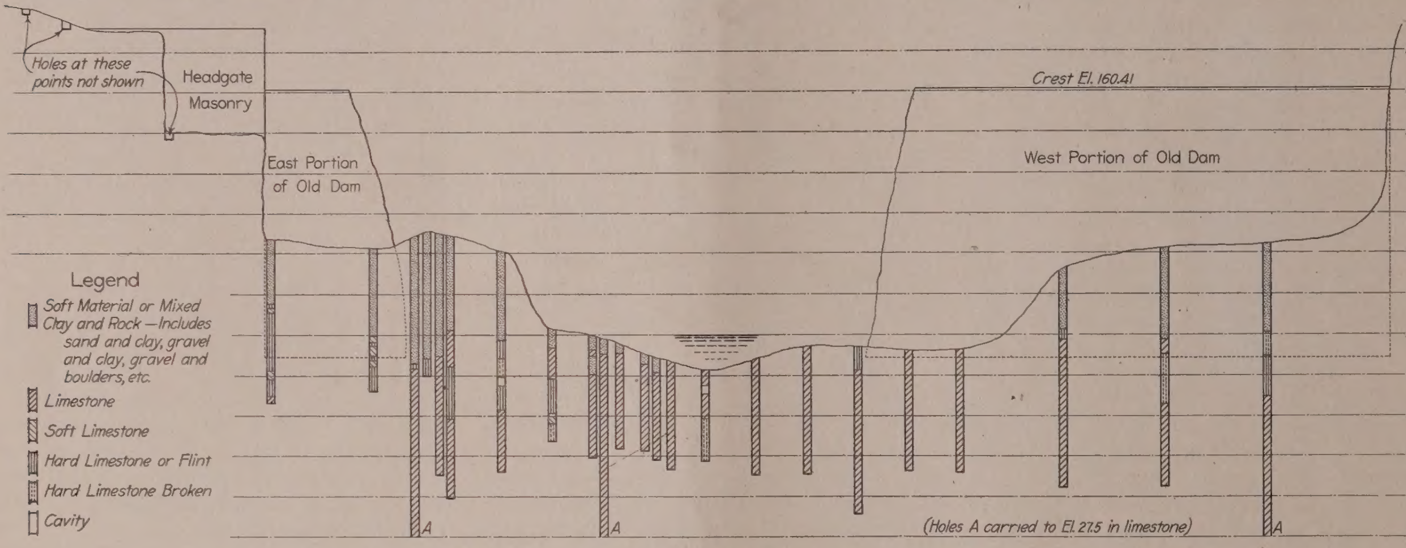
Moreover, if contractors and waterworks superintendents understood more about the matter, it would in many cases be possible to construct and maintain filtration plants at less expense than at present. Frequently it has been difficult to secure satisfactory filtering material because of the methods of analysis employed and the requirements as to size described in engineering specifications. Mr. Hazen holds contrary views, but it should be remembered that for slow-sand plants the quantities of sand are so large that the contractors can afford to become educated up to the scientific terms of the engineer. Representatives of the rapid-filter companies, who use relatively small amounts of sand at points scattered throughout the country, feel keenly the need of simplified methods. The preparation of a few carloads of sand on hard and fast lines which are only half understood does not appeal to the local sand dealer and he fails to bid on that part of the contract, though eager to sell the sand for the concrete.

There is no probability that the engineering profession will adopt the terms now used in the mechanical analyses of filter sands for the analyses of sands and gravels used for other purposes, such as the proportioning of concrete and paving mixtures. Uniformity and standardization, therefore, can be obtained only by a revision of methods in vogue in the waterworks field.

# Hollow Reinforced-Concrete Structure Replaces Dam at Austin, Texas, Which Failed Fifteen Years Ago

## Part I—Which Reviews History of Previous Dam and Describes Work for Rendering Seamy Rock Impermeable—Cutoff Trench Grouted After Compressed Air Tests

THE Austin, Texas, Dam, famous because of its failure 15 years ago, has now been replaced by a hollow reinforced-concrete structure, forming part of the hydroelectric development of the city of Austin. The new project makes use of such portions of the old structure as remained standing, and presents a number of unusual features—the design of the dam itself, the use of automatic crest gates and the arrangement of the sluice gates, which are mounted on the face of the dam with their entire operating mechanism submerged. The power plant, forming part of the development, has a departure in wheel chambers—separate and independently built reinforced-concrete boxes of cylindrical section. These and other features will be discussed in this article, which is condensed from a description prepared by Frank S. Taylor, resident engineer of the City Water Power Company, Austin, Texas. The article will be published in three parts.



NEW AUSTIN DAM IS LOCATED ON SITE OF OLD STRUCTURE—THIS CHART SHOWS RESULT OF BORINGS

### Historical

In May, 1893, the first dam across the Colorado River near Austin, Texas, was completed. The development attracted world-wide attention, because it was then the greatest dam in the world, both height and length considered. The dam was of gravity section, made of cyclopean concrete masonry, faced with cut, red granite blocks. Its height was 60 ft. above low water, and the total length 1235 ft., of which practically 1100 ft. was spillway, 110 ft. bulkhead on the eastern end, and 25 ft. bulkhead on the western end.

The development was a municipal undertaking, the money being raised by the city of Austin on bonds, of which $1,400,000 were issued.

The river bed for many miles up and downstream, and, in fact, practically all the underlying rock of the country, is limestone, varying from so-called "dobe," a disintegrated limestone, to the hardest variety. The river bed is seamed with fissures, and there are small cavities of frequent occurrence, ranging from a few inches to several feet in largest dimension. These cavities are encountered sometimes as far as 20 ft. below the surface of the river bed.

### Failure

Shortly after construction was begun, foundation difficulties began to develop and were followed by other difficulties due to the personnel of the city government. The engineers in charge could not get their instructions followed, their plans executed or specifications fulfilled. They resigned, one after the other, and their places were filled by other engineers, who in turn resigned. In spite of these difficulties, some 600 ft. of the western end of the dam was placed on good, firm rock. The rest of the work was done more with a view to completing the dam than to finding a foundation to support it. The draft-tubes from the old power station were so located that they discharged against the downstream toe, and the waters from these draft tubes eroded the soft strata underneath. This condition continued for seven years, when the inevitable happened.

On April 7, 1900, under a flood of 133,000 sec.-ft., which gave a thickness of water of nearly 11 ft. over the crest, a section about 200 ft. long tilted backward, slid downstream, righting itself as it moved, and finally came to rest about 100 ft. below the axis of the dam. The impounded waters rushing through the opening, eroded the remaining portions of the dam, widening the gap until some 450 ft. of the total length was removed. The power house was wrecked, and several people in it were drowned. Full discussion of the disaster will be found in the Engineering Record, Vol. 41, 1900.

### Steps Towards Reconstruction

For several years after the failure reconstruction was agitated from time to time. Engineers were employed to report on the location of the dam. Several reports appeared, the general opinion being that the character of the river bed and arrangement of strata made it impossible to construct a safe and water-tight dam on the same site.

About 6 years ago, the municipality had a series of rock borings made, some through the crest of those portions of the dam still remaining, the others in the gap, with the result that it was found that the underlying rock was good, hard, and compact after a certain depth below the river bed, and below the footing of the old dam, was reached. This encouraged the municipality to undertake some means whereby the dam could be rebuilt.

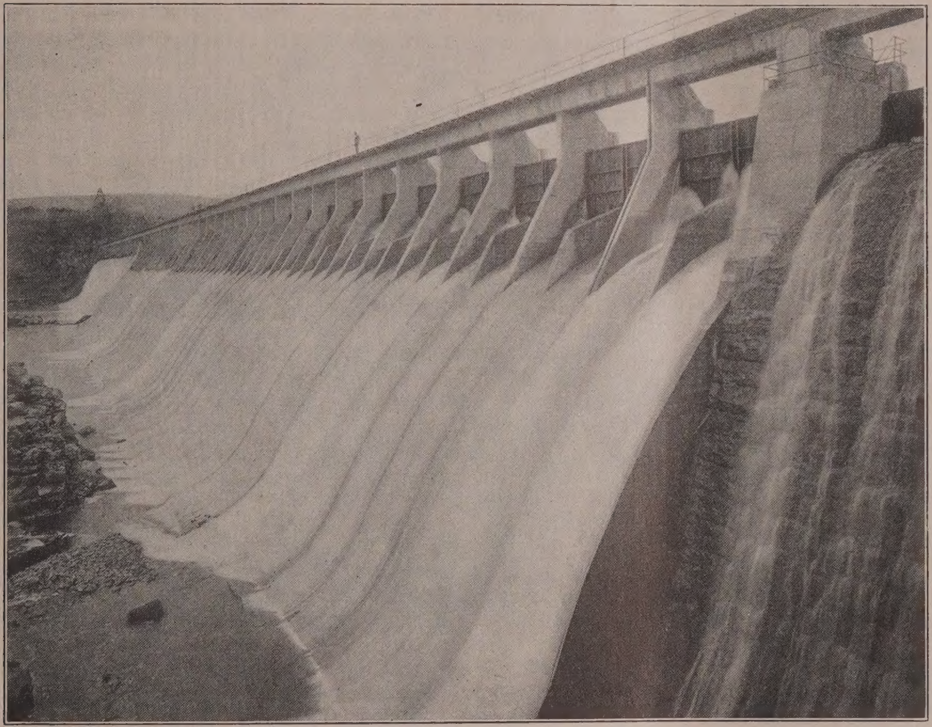
After much negotiation between the city and private companies a franchise was granted to William D. Johnson, of Hartford, Conn., on Sept. 11, 1911, which provided that the dam and power plant would be constructed by Johnson, and, on completion, turned over to the city, Johnson to receive $100,000 in cash on completion and acceptance, and $64,800 per annum in semi-annual payments for 25 years, making a total payment of $1,720,000, the cash value of which is approximately $1,000,000. In order to carry out the terms of the franchise and to do the construction work, a corporation was formed called the City Water Power Company, which issued $750,000 in 5 per cent, gold, sinking fund bonds. The bonds were underwritten by Lawrence, Barnum & Company, bankers, of New York.

Lamar Lyndon, of New York, was made consulting engineer, and Mr. Taylor, resident engineer. The work was carried out under their direction.

### New Plans

The designs for the new development were begun early in 1910, and work was started Sept. 22, 1911. It was prosecuted on force account from the latter date until June, 1912, when a contract was entered into with the William P. Carmichael Company, of St. Louis. Work progressed until April, 1913, after which practically nothing was done until Jan. 10, 1914, the period being lost by reason of an unprecedented series of heavy floods, culminating in that of Dec. 3, the highest recorded in the history of the river. It is estimated that the flow was between 220,000 and 230,000 sec.-ft.

After considerable study it was decided that the new development could be made best and most cheaply on the site of the original dam. While the foundation work would be more costly than if the location were moved upstream some 800 or 900 yd., the expense was more than counterbalanced by the possibility of using the existing section, which comprised 520 ft. of dam in good condition and on satisfactory foundation, together with all the bulkhead masonry, which was thoroughly good, though not on proper foundation. Moreover, the larger part of the old power house, still standing, could be utilized.



CONCRETE DAM REPLACES STRUCTURE WHICH FAILED, AUSTIN, TEXAS

Part of old dam at right-hand end of picture. Note difference in crest elevations. Small piers on concrete dam support automatic crest gates.

### Limiting Flow Over Old Section

There was, however, one difficult condition to be met. In order to get the proper amount of power and lake storage, the water level would have to be raised from the old elevation of 60 ft. to 65 ft. above low water, which meant that with 11 ft. of water over the crest during flood, the maximum water level would be 76 ft. above low water instead of 71 ft. The portion of the old section which had given way failed under a 71-ft. water level, and it was imperative that the portion of the old section remaining should not be subjected to as great stress as it had previously withstood. This required that the maximum water level should never rise even as high as 71 ft. above low water. It appeared as if these two conditions could not be reconciled. However, after considerable study, a type of crest gates, to be described in Part 2 of this article, was adopted.

With this arrangement, the new section of dam was built only 51 ft. high from low water to crest, or 9 ft. lower than the old section. The crest gates on the old section are 6 ft. high, and those on the new section, 15 ft., so that the upper edges of the crest gates are all at the same level, 66 ft. above low water. When the water level is at an elevation of 65 ft., or less, the crest gates are tightly closed. An increase of 6 in. in the elevation of the lake will make the crest gates automatically overturn, letting the water flow out over the crest of the dam. When the level has fallen 12 to 15 in. or about down to the 64-ft. elevation, the crest gates automatically close.

It is estimated that with a discharge of 200,000 sec.-ft., the thickness of the water over the crest of the new section will be 18 ft., and over the old section 9 ft. This means that the present dam will pass 50 per cent more water than did the old dam when it failed, but the elevation of the water is only 9 ft. above the crest of the old dam, while it was 11 ft. above the crest when the weak section went out in 1900. Since the overturning moment varies as the cube of the head of water against the dam, and the sliding force varies as its square, the stresses to which the old section will be subjected can never equal those which it has already resisted. The depth of the water below the low-water elevation varies from 5 to 20 ft., so that the total depth of water behind the dam varies from 70 to 85 ft.

As has been pointed out, the river bed and the whole surrounding country is underlaid with limestone, which has many crevices, seams and cavities, and these are to be found at varying depths below the surface. It was decided to fill all the underlying seams and cavities with grout, and, on the reconstructed river bed, to build a hollow dam of reinforced concrete, of such form that there could be no uplifting force from any leakage of water under it. Furthermore, as a portion of this new section, a cutoff wall was to be sunk on the upstream side, to such a depth that its lower edge would be below all permeable strata.

The unit pressure adopted for the wall footings was 166 lb. per square inch, with a few walls where this pressure was carried up to 200 lb. per square inch. Wherever the rock was hard and firm for a depth of 4 ft., it was considered satisfactory to resist these bearing pressures. Trenches were cut in the rock to receive the footings, and in the bottoms of these trenches, at intervals, drill holes were made 4 ft. in depth. Wherever these holes passed continuously through solid rock, the trench was accepted as suitable for the footing. Wherever the rock was hard but a cavity encountered, grout was forced into the cavity and allowed to harden before the footings were built. Wherever soft and defective stone was found, the excavation of the trenches was continued until a point was reached below which the thickness of good rock was at least 4 ft. This practice applied to the trenches in which the buttress and supporting walls were built.

### Cutoff Wall

The cutoff wall was carried down, in many instances, a considerable depth below the footings of the buttresses. This wall, on the upstream side of the dam, was poured in a trench which had previously been tested by numerous drill holes, put down in the bottom of the trench. Where defects were found, they were remedied by grouting. The test holes were first spaced 12 ft. apart in the bottom of the trench. Compressed air was turned into them, one by one, to discover underground connections between adjacent holes. Wherever the compressed air would blow out of one or more of the other holes, it was considered that the entire seams or crevices between the two holes were reached by the drill holes then made. Grout would then be forced into one of the holes until it began to blow out of the others. It was then considered that the rock lying below the cutoff wall trench and between the holes had been made tight. Wherever no connection could be established between the holes 12 ft. apart, intermediate holes were drilled, thus making the drill holes only 6 ft. apart along certain portions of the cutoff-wall trench. If, after this was done, no connection could be established between adjacent holes, additional holes intermediate to those 6 ft. apart were drilled, bringing the distance to 3 ft.

In nearly every instance where these holes were made water flowed freely through them, sometimes spouting up 3 or 4 ft., thus proving conclusively connection between the holes made inside the cofferdam and the surrounding body of water. As grout would be forced into the holes, the velocity of water flowing out of them would gradually diminish, until it would entirely stop. In many cases, where grout was forced into a hole, the flow of water through other holes, sometimes as far distant as 50 ft., would be stopped and the grout would finally show, rising out of adjacent holes, proving that the underground seams between these two holes had been thoroughly filled with grout. In placing the grout the pressure on the liquid mixture was gradually increased from a few pounds to a maximum of 80 lb.

Subsequent to the completion of the work, a cofferdam was built on the downstream side of the river and pumped out, and all leakage observed. There was practically no leakage through the foundation, or through the strata below the cutoff wall.

*Part 2 will be printed next week. It will describe the special features of the dam, including the crest and sluice gates.*

# Needless Grade Separation Required of Railroads

### C. E. Smith of the Missouri Pacific Discusses Grade-Crossing Law—Deplores Unreasonable Demands by the Communities

SEVERAL comments from railroad chief engineers were published April 10, on page 455, on the article "Grade-Crossing Law and Its Effect on Grade-Crossing Elimination," which appeared in the Engineering Record of March 13, page 327. Other railroad engineers of experience were asked to discuss the subject, and a comment was received from C. E. Smith, assistant chief engineer of the Missouri Pacific Railway. Mr. Smith thinks too many demands are made upon the railroads by individual communities for grade-crossing elimination, which are such a drain upon the resources of the railroads that the roads are unable to establish a definite program, attacking the most dangerous crossings first. He is certain that with a fair distribution of costs the demands are more moderate and equitable. He deplores the attempts of communities to evade even their legal share of the expense, and thinks the railroads suffer especially unfair treatment in the matter of new streets opened across the railroad. He also believes the utilitarian and ornamental features should be separated, the community paying for the latter. His discussion follows.

The article on "Grade-Crossing Law and Its Effect on Grade-Crossing Elimination" presents much food for thought. It is not true that railroad engineers generally are not familiar with what is being done on this subject throughout the country, but rather that the apparent apathy referred to is the result of great difficulty that has been encountered in endeavoring to combat public sentiment and clamor and political preferment in the handling of such matters.

#### Unnecessary Work Forced on Railroads

It is a fact that on many roads there is no general program for grade-crossing elimination, largely for the reason that the amount of this work forced upon the roads by the public is usually greater than can be easily provided for, and while the railroad engineers would like to apply the funds that are spent to the crossings of heaviest traffic in a predetermined order, that becomes impossible on account of the haphazard way in which the public presses for action, first at one point and then at another. The greatest difficulty in arriving at a program which will provide for the elimination of the busiest crossings is the difficulty of having the various communities adopt a common standard, as each community presses and works for the elimination of some of its crossings. The amount of traffic at the crossings does not always appear to be the sole consideration, as crossings of lighter traffic are frequently chosen by the public officials for reasons of expediency, frequently to satisfy residents within certain sections.

Where the State laws do not definitely determine the apportionment of cost, or where they place the greater part of the burden on the railway companies, the public officials frequently demand more grade-crossing separation than would be the case if a portion of the cost had to be borne by the community; that is, the apportionment of cost among the various parties at interest usually creates a feeling of responsibility in all minds, with the result that demands are more moderate and results more equitable.

#### Evasion of Existing Laws

Even where State laws place a portion of the burden, such as damages to abutting property, on the community, effort is frequently made to evade the responsibility through various technicalities in order to place the entire burden upon the railway company. In many cases where the public officials have found it possible to burden the railway company with the entire cost they have shown no disposition even to close the grade crossings, insisting in many cases upon the construction of separated crossings while also insisting upon the continuation of the crossings at grade.

In some cases it is very difficult to secure equitable relief even through the courts. As tending to show that communities will endeavor to compel railway companies to perform certain acts in grade-crossing elimination that are permitted by law but still are not equitable, the following utterance of the U. S. Court of Appeals in a recent grade-crossing case will be of interest:

"It may be conceded that if the case before us were not one of the exercise of the police power of the State through the medium of a city, but were to be determined according to equitable principles, we would think the street railroad company should be required to contribute to the cost of the viaduct, and perhaps the city itself as the representative of other interests."

#### Other Utilities Affected Should Help

The communities as a rule have not shown sufficient respect for the rights of the railroads to compel public utilities to bear a portion of the burden. Without doubt public utility companies holding franchises for conduits and pipe and wire lines should bear the portion of the cost made necessary by the presence of their facilities, and without doubt street railway companies should participate in proportion to the increased cost caused by their presence. In many cases, however, the communities make every endeavor to compel the railway companies to bear the burdens of the other public utilities. This is unfortunate as it necessarily results in a more restricted program of grade-crossing elimination. Funds that would otherwise be available for the elimination of additional crossings are thus dissipated for expenses of which the railway company should be relieved.

Where the laws are indefinite or impose an unfair portion of all of the cost upon the railway companies, experience has proved that the best results can be obtained through friendly negotiations with the public officials, and where the public officials are broad-minded men they will frequently consent to having the community relieve the railway company of a considerable portion of the cost in order to get results that might otherwise be delayed for several years through litigation or unfriendly negotiation.

#### Would Separate Utilitarian and Ornamental Features

It has always appeared to the writer that the utilitarian and ornamental features should be separated. Without a doubt the railway company should participate in a fair proportion of the cost of providing the utilitarian features, but the additional cost of providing viaducts of unusual width for boulevard purposes, or structures of unusual beauty and design for ornamental purposes, should undoubtedly be borne by the community demanding such increased expenditures.

While it is undoubtedly true that at crossings of unusually heavy railroad and highway traffic the cost of maintaining and watching the crossings and operating over them when capitalized may represent a considerable portion of the cost of elimination, such a condition is very rare, and it is usually the case that the increased cost of maintenance of the additional construction exceeds the saving, leaving the railway company to carry the increased capital expenditure without any collateral saving.

#### New Crossings

The communities appear to be particularly unfair with reference to the opening of new crossings over railway tracks and the construction of separated crossings for new streets. There appears to be no good reason why the community should not recognize the seniority of the railway company at such points and bear a very large portion, if not all, of the cost of such new crossings. It has never been clear to the writer why the right of way of a railway company should be subject to condemnation for such use without the necessity of paying the railway company damages that would, if the property were used for other purposes, have to be paid to the owner.

It is difficult to find a reason for the great agitation for the elimination of grade crossings, especially in sections of the country where neither highway nor railroad traffic have reached the maximum. The record of casualties discloses comparatively few accidents and deaths resulting at grade crossings, and shows also that the number of accidents on account of trespassing on railroad right of way are many times those at the grade crossings. While the public is raising a great clamor against grade crossings and unfairly compelling expenditures of large sums for their elimination, practically no co-operation whatever is shown by the public with the railroads in decreasing or eliminating the evils of trespassing. A campaign of law enactment and law enforcement against trespassing on railroad rights of way extended over a few years and resulting in an inappreciable expenditure would save more lives than can be saved by the expenditures of years for grade-crossing elimination.

# Will Utilize Existing Irrigation Works to Secure Useful Data

A PLAN for utilizing existing irrigation works to secure data of value and financial benefit in future design is set forth in the March issue of the "Reclamation Record." It is urged that experimentation and observation be carried on at these existing works to determine various factors and elements regarding which little is known. The "Reclamation Record" will serve as a medium for the exchange of the data developed, and will endeavor to present in each issue a short article of results of some particular investigation.

Among the subjects suggested for investigation are the following:

(*a*) Loss of head through various types of headgate structures.

(*b*) Loss of head at canal contraction and entrance to flumes, pipes, tunnels, etc.

(*c*) Loss or gain of head at canal enlargement and outlet of flumes, pipes, tunnels, etc.

(*d*) Coefficient of discharge of reservoir regulating valves.

(*e*) Effectiveness of stilling pools.

(*f*) Surge or fluctuation of head in power-plant pipes.

(*g*) Effect of curvature or resistance in pipes, flumes, and lined channels.

(*h*) Value of *n* for lined channels, flumes, and tunnels.

(*i*) Depth over spillway lip of siphon spillway to start siphon.

(*j*) Efficiency of spillway siphons.

(*k*) Strength of reinforced-concrete pipe.

(*l*) Coating of metal pipe.

(*m*) Life of wood pipe and metal flumes.

(*n*) Seepage losses from canals in various materials.

(*o*) Seepage and evaporation from reservoirs.

(*p*) Drainage runoff from seepage of irrigation water.

## Sand Analysis Methods Can Be Improved, Contends Mr. Fuller

GEORGE W. FULLER, consulting engineer of New York, submitted the following discussion of Philip Burgess' paper on methods of sand analysis (see Engineering Record, May 22, page 644) presented at the Cincinnati convention of the American Waterworks Association:

"The writer is in sympathy with Mr. Burgess' viewpoint in the effort to secure simplification and standardization of sieves used for the mechanical analysis of sands. Unquestionably it has been a fact in the past that contractors, sand dealers and others have experienced marked difficulty in knowing what was desired by engineers who specified the "effective size" of sand, "uniformity coefficient," and limitations in quantities of sand particles either above or below a stipulated size expressed in fractions of a millimeter. Any procedure which will materially improve this situation, as handled by large numbers of people who now grope more or less in the dark, should certainly be welcome.

"On the other hand it should be kept clearly in mind that methods of measurement used for a period of 20 or 25 years should not be put aside lightly until important practical experience gained in past years, with more or less unsatisfactory methods, can be translated for the benefit of the technician with substantial certainty into terms of the new and improved method of measurement which it is desired to adopt. It is the belief of the writer that the methods can be improved without sacrificing materially our practical grasp of the significance of the fund of knowledge accumulated in the past."

## Why Denver Uses So Much Water

DENVER does not head the list of cities in the matter of water consumption per capita, but for a non-manufacturing city its rate of 200 gal. per day is high.

TWELVE SPRINKLERS WATERING THE DENVER CAPITOL GROUNDS

The accompanying photograph showing an even dozen sprinklers caught by the camera at work on the capitol grounds indicates where the water goes. Incidentally this 10-acre lawn, which requires 1,200,000 gal. per month during the summer, is considered one of the assets of the city.

## How Tracings Are Reproduced for the Federal Evaluation

A YEAR and more ago, when the subject of maps and plans to be furnished by the railroads to the Division of Valuation of the Interstate Commerce Commission was under discussion, the railroads vigorously opposed the furnishing of tracings, on the ground that much extra work and expense would be required to re-trace all existing plans, and that blueprints would be at once far cheaper and more serviceable. The Government insisted, however, on the tracings, and it was brought out that it was possible to reproduce a tracing from a tracing by photographic processes. The best way of doing this was described by P. E. Thian, valuation engineer of the Northern Pacific Railway, in a paper he recently presented before the North Western Association of Members of the American Society of Civil Engineers, at Minneapolis.

In the first place a blueprint on specially prepared paper is made from the original tracing to be duplicated. This is laid face down on a gelatine surface which is prepared by pouring molten gelatine on a zinc plate while the latter is in an inclined position, forming a thin even coating which quickly hardens in a cool atmosphere. To obtain this cool atmosphere some air refrigerating process is employed.

When the gelatine coating sufficiently hardens the zinc plate is laid on a horizontal bed, and the blueprint is applied and pressed on the surface of the gelatine. The lines on the blueprint affect the part of the gelatine with which they come in contact, so that when the blueprint is removed and the pad is run over with an ink roller, the ink adheres to the lines on the gelatine, which correspond to the lines on the blueprint, while the remainder remains unaffected. The tracing cloth on which it is desired to reproduce the original tracing is then applied and lightly pressed, thereby receiving an impression of the ink lines.

It can be readily seen that a blueprint of any size, of any portion of an original tracing, can be made, and a reproduction secured on tracing linen or paper. After the tracing is reproduced, border lines and triangles are added to conform to the Government specifications, and the new tracing is ready for filing with the Government.

One or more reproductions can be made from one impression on a gelatine pad, simply by re-inking same, which makes it possible for the railway to retain exact duplicates of the maps furnished to the Government.

## Wash-Water Salvage at an Iron Removal Plant

BY the construction of a $2000 basin for the storage of used wash-water the Urbana & Champaign Water Company now loses daily but 16,000 gal. of well-water in washing the iron removing rapid filters. Previously the loss per day was from 200,000 to 250,000 gal. according to statements of H. E. Babbitt in a paper presented to the Illinois Section of the American Waterworks Association March 10. This amount was equivalent to from 6 to 20 per cent of the nominal capacity of the plant. At the rate charged consumers the water was worth $4,000 a year. Water is obtained from wells, one of which cost about $2,000 and produces about the amount of the former daily loss.

A 90,000-gal. reinforced-concrete, rectangular basin was constructed with monolithic walls, mostly in excavation. Imperviousness was sought by using a 1:2:4 concrete and by applying two coats of Ironite. No such provision was necessary, however, as the iron in the water filled such cracks as formed, successfully stopping any leakage.

After passing through the filters the wash-water is dosed with 2 grains of alum per gallon. Clarification is rapid but all the time available for settling is made use of; ordinarily about 2 hours is the period.

In the discussion of Prof. A. N. Talbot's paper on the plant, delivered before the Illinois Water Supply Association last year, W. W. DeBerard suggested that some of the difficulties encountered by the necessity for frequent washing of the filters with a fire hose or by other laborious means might be overcome by using an additional wash-water manifold immediately above the sand layer. Such a grid was constructed by W. I. Ainsworth, operator at the plant, of old material on hand supplemented by new fittings. It is made up of a 2-in. wrought iron manifold with ¾-in. branches on 11-in. centers. One-eighth inch holes on 5-in. centers are bored on the under side of the manifold and branches. The grid covers one-half of the area of the filter, but because of the clogging of the ⅛-in. holes by iron deposits, only one-quarter of the area of the filter is affected by the grid. The result has been to obviate the necessity of washing this unit with a fire hose. The loss of head on this filter after washing will increase from 18 to 24 in., in the same time that the adjacent units are increasing from 18 in. to 52 in. It is planned to install similar grids with 3/16 in. holes on all the filters.

## Erectors of the Monroe Street Viaduct, Spokane

Inadvertently it was stated in the short article in the Engineering Record of May 1, page 564, on the erection of the Monroe Street viaduct in Spokane that the Bates & Rogers Construction Company was the contractor for the work. This company had a general contract for a large part of the work on the Spokane improvement, including the substructure and the concrete deck for the Monroe Street viaduct. The steel, however, was erected by Wakefield & O'Neel, as stated in a more extended article on the Spokane improvement, in the issue of Feb. 20, page 234.

## Daily Cost-Data Sheets on Concrete Road Construction

During 1914 the Association of American Portland Cement Manufacturers gathered statistics covering the actual costs of a number of concrete roads and pavements. The costs obtained were for labor, teaming, mechanical equipment, preparation of subgrade, and the mixing, placing, leveling and curing the concrete. In order to make logical comparisons of costs for different sections of the country all "cost factors" that do not enter into the cost of the road "crust," such as earth and rock excavation, overhaul, stone sub-base, etc., were eliminated.

For ease of tabulation the cost data were divided into five major items: Labor, teaming, mechanical equipment, actual quantities used in constructing the concrete pavement, and various miscellaneous items.

The labor, exclusive of that used on mechanical equipment and teaming, is classified by location so that a comparison could be easily made between separate jobs regarding the efficient handling of men. The cost of teaming is sub-divided so that comparisons may be very readily made and under "Mechanical Equipment" the cost of plant, the interest and depreciation and the cost of labor and supplies have been given.

Economy dictates that the amounts of materials used should closely check with those theoretically required. The tabulation is arranged so that the cost of materials may be quickly lumped.

The miscellaneous items are naturally of small moment, but they have been added so that the figures may be conservative.

Approximately 1,500,000 sq. yd. of pavement were covered by this method of estimating distributed as indicated in the accompanying table.

The grand average figures are weighted. In general contract work the methods of cost accounting are more or less haphazard and it would doubtless pay the road contractor to evolve a simple cost data scheme along the lines suggested.

Average Cost of Concrete Roads (1914)

| State | Labor | Teaming | Mech. Equip. | Materials | Misc. | Total Number | Sq. Yd. |
|---|---|---|---|---|---|---|---|
| Connecticut | $0.181 | $0.142 | $0.046 | $0.752 | $0.010 | $1.088 | 200,066 |
| Florida | 0.108 | 0.028 | 0.003 | 0.838 | 0.014 | 0.991 | 13,000 |
| Indiana | 0.134 | 0.130 | 0.044 | 0.777 | 0.022 | 1.017 | 89,794 |
| Illinois | 0.136 | 0.101 | 0.033 | 0.528 | 0.016 | 0.814 | 17,970 |
| Iowa | 0.213 | 0.084 | 0.028 | 0.789 | 0.036 | 1.116 | 90,364 |
| Kansas | 0.396 | .... | 0.026 | 0.819 | 0.007 | 1.248 | 1,503 |
| Kentucky | 0.146 | 0.214 | 0.020 | 0.477 | 0.018 | 0.875 | 4,144 |
| Maryland | 0.111 | 0.128 | 0.065 | 0.716 | 0.057 | 1.077 | 36,211 |
| Massachusetts | 0.195 | 0.104 | 0.039 | 0.609 | .... | 0.947 | 26,200 |
| Michigan | 0.222 | 0.032 | 0.021 | 0.655 | 0.050 | 1.028 | 92,217 |
| Mississippi | 0.261 | 0.085 | 0.150 | 0.642 | 0.094 | 1.232 | 12,031 |
| Missouri | 0.209 | 0.133 | 0.027 | 0.656 | 0.059 | 1.045 | 22,376 |
| New Hampshire | 0.126 | 0.097 | 0.032 | 0.907 | .... | 1.162 | 6,066 |
| New Jersey | 0.179 | 0.089 | 0.016 | 0.797 | .... | 1.091 | 8,355 |
| New York | 0.156 | 0.085 | 0.055 | 0.666 | 0.050 | 1.027 | 730,982 |
| Ohio | 0.181 | 0.091 | 0.067 | 0.642 | 0.009 | 0.946 | 58,968 |
| Pennsylvania | 0.279 | 0.091 | 0.031 | 0.742 | .... | 1.269 | 10,072 |
| Texas | 0.316 | 0.117 | 0.007 | 0.668 | 0.016 | 1.123 | 6,642 |
| West Virginia | 0.098 | .... | 0.060 | 0.912 | .... | 1.070 | 10,045 |
| Wisconsin | 0.188 | 0.110 | 0.045 | 0.682 | 0.023 | 1.033 | 61,879 |
| Grand Average | 0.183 | 0.105 | 0.040 | 0.719 | 0.046 | 1.058 | *1,498,883 |

*Exclusive of profits and overhead charges.

Standard Form for Tabulation of Cost Data

State of ...................... Contract No. ...... .................... to ....................Co.
Work Began or Completed...............Began or Finished Concrete...................Working Days
Cross Section 4¾ in.-6¾ in.-4¾ in.-16 ft. wide. Contractor ..........................................
Equipment 10 Ton Roller (......)........Traction Engines ..........................Wheel Scrapers
..........Scarifier 1-2 H. P. Pump................Sand Washing Plant Capacity....................
1 Hoist 2 Stone Trucks
Daily Report—Sept. 7, 1914. ........................................Road Ass't

| Labor | No. Hrs. | Wages per Hour | Total Cost | Total Amount Handled | Cost per Cu. Yd. | Sq. Yd. Cost per Pavement |
|---|---|---|---|---|---|---|
| On Sand at Pit or Washer | .. | | | | | |
| On Sand at Work | 3⅓ | ..... | 5.00 | 49 cu. yd. | $0.102 | $0.0069 |
| On Stone at Cars or Quarry | 6⅔ | ..... | 10.00 | 99 cu. yd. | 0.102 | 0.0138 |
| On Stone at Work | .. | ..... | .... | ...... | ..... | ..... |
| Wheeling Sand at Job | 40 | $0.175 | 7.00 | 49 cu. yd. | ..... | 0.0097 |
| Wheeling Stone at Job | 80 | 0.175 | 14.00 | 99 cu. yd. | ..... | 0.0194 |
| On Mixer, Loader | 30 | 0.175 | 5.25 | | | 0.0072 |
| Engineman | 10 | 0.30 | 3.00 | | | 0.0041 |
| Fireman | 10 | 0.20 | 2.00 | | | 0.0028 |
| Chute or Bucket | .. | ..... | .... | | | 0. |
| Sub Grade before Mixer | 10 | 0.175 | 1.75 | | | 0.0024 |
| Sub Grade behind Mixer | .. | ..... | .... | | | 0. |
| Leveling Concrete | 20 | 0.175 | 3.50 | | | 0.0048 |
| Templet Men | 20 | 0.175 | 3.50 | 124 cu. yd. concrete | | 0.0048 |
| Finishing Pavement | 20 | 0.175 | 3.50 | | ..... | 0.0048 |
| Forms, Joints and Reinforcement Men | 20 | 0.175 | 3.50 | | | 0.0048 |
| Wetting Pavement | 5 | 0.175 | 0.875 | | | 0.0012 |
| Covering New Pavement | 20 | 0.175 | 3.50 | | | 0.0048 |
| Superintendent | 10 | 0.750 | 7.50 | | | 0.0103 |
| Watchmen | 5 | 0.175 | 0.875 | | | 0.0012 |
| Timekeeper | 10 | 0.300 | 3.00 | | | 0.0041 |
| Foremen | 10 | 0.400 | 4.00 | | | 0.0055 |
| Waterboy | 10 | 0.150 | 1.50 | ...... | ..... | 0.0021 |
| Engineman at Sand Washer | .. | ..... | .... | ...... | ..... | ...... |
| Total Labor | | | | | | $0.1147 |

| Teaming | No. Trips | Cost per Day | Total Cost | Av. Haul or Pump | Amount Hauled or Pumped | Cost per Cu. Yd. Mile or 1000 Gal. Mile | Cost per Cu. Yd. at Job | Amt. per Sq. Yd. Payement | Cost per Sq. Yd. Pavement |
|---|---|---|---|---|---|---|---|---|---|
| Sand | 16 | $13.95 | .... | 1,300 ft. | 49 cu. yd. | ...... | ...... | ...... | 0.0192 |
| Stone, 2 trucks | 33 | 28.78 | .... | 1,300 ft. | 99 cu. yd. | ...... | ...... | ...... | 0.0397 |
| Cement, 1 team | 21 | 18.27 | .... | 1,500 ft. | 957 sacks | ...... | ...... | ...... | 0.0252 |
| Water | .. | 6.00 | .... | ...... | ....... | ...... | ...... | ...... | 0.0083 |
| Total teaming | | | | | | | | | $0.0924 |

| Mechanical Equipment | Cost of Plant | Int. and Deprec. of Plant 0.00154 x Cost | Cost of Labor | Cost of Supplies | Cost of Sq. Yd. Pavement |
|---|---|---|---|---|---|
| Steam Roller | $2,000 | $3.08 | $3.00 | $3.00 | $0.0125 |
| Wheel Scraper | ..... | .... | .... | .... | ...... |
| Scarifier | ..... | .... | .... | .... | ...... |
| Pumps | 600 | 0.93 | 3.00 | 3.00 | 0.0097 |
| Mixer | 1,850 | 2.85 | 5.00 | .... | ...... |
| Forms | ..... | .... | .... | .... | ...... |
| Barrows, Boxes, etc. | ..... | .... | .... | .... | ...... |
| Tractor | ..... | .... | .... | .... | ...... |
| 2 Motor Trucks | 7,100 | 11.13 | 6.00 | 6.00 | 0.0319 |
| Sand or Gravel Washing Plant | ..... | .... | .... | .... | ...... |
| Stone Crushing Plant | ..... | .... | .... | .... | ...... |
| 1 Hoist | 7,000 | 10.78 | 7.00 | 8.00 | 0.0356 |
| Total mechanical equipment | | | | | $0.0897 |

Quantities and cost of materials theoretically required and actually used on {410 lin. ft. / 725 sq. yd.} of above road. Barrel of cement = 3.8 cu. ft.

| | | | Per Unit Cost | Average Haul | Total Cost at Job Excl. of Haul | Cost per Sq. Yd. of Pavement |
|---|---|---|---|---|---|---|
| Theoretical: | | | | | | |
| Cement | 237 | bbls. | $1.15 F.O.B. Cars | at job | | |
| Sand | 49 | cu. yd. | 1.63 F.O.B. Cars<br>0.77 cu. yd. Pit | at job | | |
| Stone or gravel | 99 | cu. yd. | 1.85 F.O.B. Cars<br>0.70 cu. yd. Pit | at job | | |
| Actual: | | | | | | |
| Cement | 239.2 | bbls. | | 1500 | $275.08 | $0.379 |
| Sand | 50 | cu. yd. | | 1300 | 81.50 | 0.112 |
| Stone or gravel | 101 | cu. yd. | | 1300 | 186.85 | 0.258 |
| Steel or wooden joints | 224 | lin. ft. | | | 10.08 | 0.014 |
| Total materials | | | | | | $0.763 |
| Grand total | | | | | | $1.0598 |

Notes:

The above report is taken as an average for the last seven working days: 410 linear feet per day, or 725 sq. yd. of pavement.

Amount of water used cannot be determined.

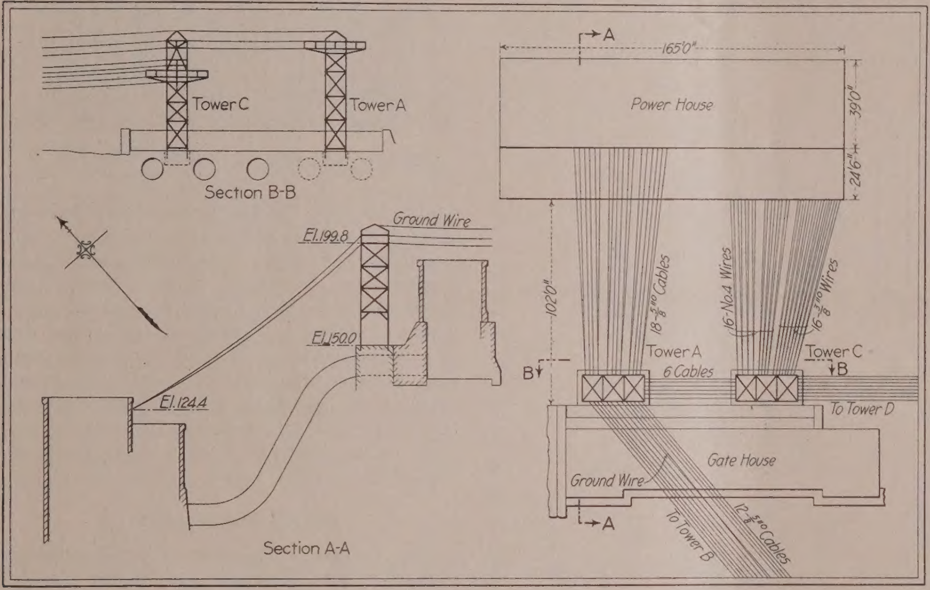
Hauling of materials by two motor trucks and one wagon.

Cost of hoist is estimated.

# Design of Transmission Towers for the Cohoes Hydroelectric Plant Analyzed

### Steel Towers Support Many Cables Making Sharp Turns and Require Portal to Clear Roadway—Special Conditions Govern Analysis of Stresses

SEVERAL unusual conditions combined to make the design of steel transmission towers for the Cohoes hydroelectric plant, described in this journal in the issues of March 20 and 27, pages 352 and 395, somewhat unique. Not only did most of these towers support entering and leaving cables at large angles with each other, but some of the cable spans contained large differences in end elevations. The difficulties encountered because of the great number of wires and cables to be provided for required a change in the original design to allow proper clearance between the live wires and the steel of the supporting towers. The solution of the problem of providing this clearance was especially difficult in one case (tower C), for which seven wire-support levels had to be adopted. Another unique feature of this construction is the portal design made necessary to provide clearance for a driveway which passes through the two towers in front of the gatehouse. Heavy solid concrete pedestals of special type were used for these towers.



PLAN AND SECTIONS SHOWING TOWERS A AND C NEAR GATEHOUSE

## LAYOUT AND DIMENSIONS

As shown on the accompanying diagram, there are two main towers, A and C, located on the driveway just in front of the gatehouse, to which the cables from the power house lead. The other two towers, B and D, are not shown. Towers A and C are situated at a much higher level than the power house, and although the wires leading to tower A leave the power house near the roof, there is still a difference in elevation of the ends of the cables of about 75 ft., as shown in section AA. The height of these towers is somewhat more than 50 ft. The number and size of cables and wires is shown on the plan view; the span for the cables leading from tower A to tower B is about 340 ft., and the span from tower C to tower D is about 170 ft.; for both cases the ends are practically at the same level, towers B and D both being approximately 40 ft. high.

Tower A is shown in the accompanying drawings. It is about 10 x 13 ft. in plan, the latter dimension having been fixed by the requirement of 11 ft. clear width of driveway, while the former figure was selected after a consideration of uplift conditions, the limiting width for clearance between the two penstocks and the economic necessity for avoiding long struts. The height was fixed by the clearance requirement of 2 ft. 6 in. for the wires over the gatehouse roof, and the panels were arranged as nearly as possible for equal slopes of the diagonals, the required 14-ft. clear height above the driveway locating the lower flange of the portal girder.

The manner in which the cables enter and leave this tower is indicated. As the live wires must always be kept at least 9 in. from any steel, strain insulators are attached to the angles by U-bolts at the points indicated on the northeast face, and lead wires (connected to the live wires several feet outside of these strain insulators) are carried on pin insulators over the steel at the required clearance.

## LOADS AND ALLOWABLE STRESSES

In addition to the dead-load weight of the tower itself and the weight of the cables, these towers were designed for a combination of sleet and wind conditions, assuming sleet of $\frac{3}{4}$-in. radial thickness and wind pressure at 20 lb. per square foot acting horizontally on the surfaces of the sleet-covered tower and the sleet-covered cables.

In computing the cable reactions at the towers the vertical components were found by using the sum of the weight of the cables and sleet, while in computing the horizontal components in the direction of the cables there was used a resultant load per foot of cable found by combining this vertical load with the horizontal wind pressure. The horizontal normal wind pressure was assumed at 6/10 of 20 lb., or 12 lb., per square foot for the cylindrical wires. When the direction of the wind was not normal this pressure was reduced by using Hutton's formula for normal pressure on roofs.

The specified allowable working stresses for the design of the steel towers, in pounds per square inch, were: Tension, 18,000; compression, $20,000 - 87.5\, l/r$, with 17,500 maximum; bearing on shop rivets, 24,000, and on bolts, 18,000; shear on shop rivets, 12,000, and on bolts, 9000; pressure on concrete masonry, 400. The maximum allowable tension in the medium hard drawn copper wire was assumed at 12,000 lb. per square inch, or about one-half the elastic limit. The steel was of structural grade, required to comply with the standard specifications for buildings as given in the Carnegie handbook, 1913 edition.

## CONDITIONS OF LOADING—TOWER A

In order to obtain the maximum possible stress for each member of tower A, five different stress conditions were considered: (1) Cables to power house broken, wind blowing from northeast, computed cable reactions (using vertical components and the horizontal components perpendicular to and parallel to the cross arm) acting at the cables leading to Towers B and C; (2) cables to tower B broken, wind blowing from southwest, computed cable reactions acting at each cable leading to tower C and to the power house; (3) all cables working, wind from the northwest; (4) all cables working, wind from the southeast (a case evidently less severe than case 3, and hence not computed separately); (5) torsion condition—cables leading to power house from northwest end of cross arm broken, other forces the same as for case 3.

As an example of the manner in which the external loads for these conditions were obtained, consider case 1. The $\frac{5}{8}$-in. cables weigh 1.1 lb. per linear foot, and the $\frac{3}{4}$-in. layer of sleet weighs 1.3 lb., giving 2.4 lb. per linear foot vertical load. The normal horizontal wind pressure on the $2\frac{1}{8}$-in. sleet-covered wire, using 12 lb. per square foot, is about 2 lb. per linear foot. For each cable leading to tower B the normal component of this wind pressure is taken at 1.7 lb. per foot by the Hutton formula (wind from northeast), and the resultant horizontal reaction for the 340-ft. span is $1.7 \times 340/2 = 289$ lb. The vertical component for this span is $2.4 \times 340/2 = 408$ lb. The horizontal component in the direction of the cable was obtained by using the resultant of 2.4 lb. vertical load and 1.7 horizontal wind pressure, or 2.9 lb. per foot for $w$ in the formula $H = wL^2/8S$ for horizontal reaction $H$ in terms of sag $S$ and load per foot $w$ for a horizontal span of length $L$. The value of the sag $S$ is fixed in field erection as specified by the designer. By graphically combining the resulting $H$ with the horizontal reaction from the wind, and then scaling off the components parallel to and perpendicular to the cross arm, the forces acting in the planes of the sides of the tower were obtained.

## CABLES WITH ENDS AT DIFFERENT LEVELS

The cables between tower A and the power house have a difference in end elevations of about 75 ft. In obtaining the reaction for Case 2, therefore, this slope must be considered and its effect on the tower reactions determined. The horizontal component of the cable pull can be computed by using the same formula quoted above, substituting for sag $S$ the normal distance from the chord to the cable at the center, and for length $L$ the horizontal span. An article on this subject, entitled "Graphical Statics Applied to Transmission-Line Calculations," by Alfred Still, may be found in the Electrical World of Aug. 2, 1913, page 230. The vertical components of the reactions at the two ends of the cable are, of course, not equal, and can be found from the equal horizontal components when the directions of the end reactions are known. The latter were fixed in this design by trial, using a carefully constructed graphical diagram of a curve giving a resulting maximum tension in the cables at the higher end less than the allowable stress.

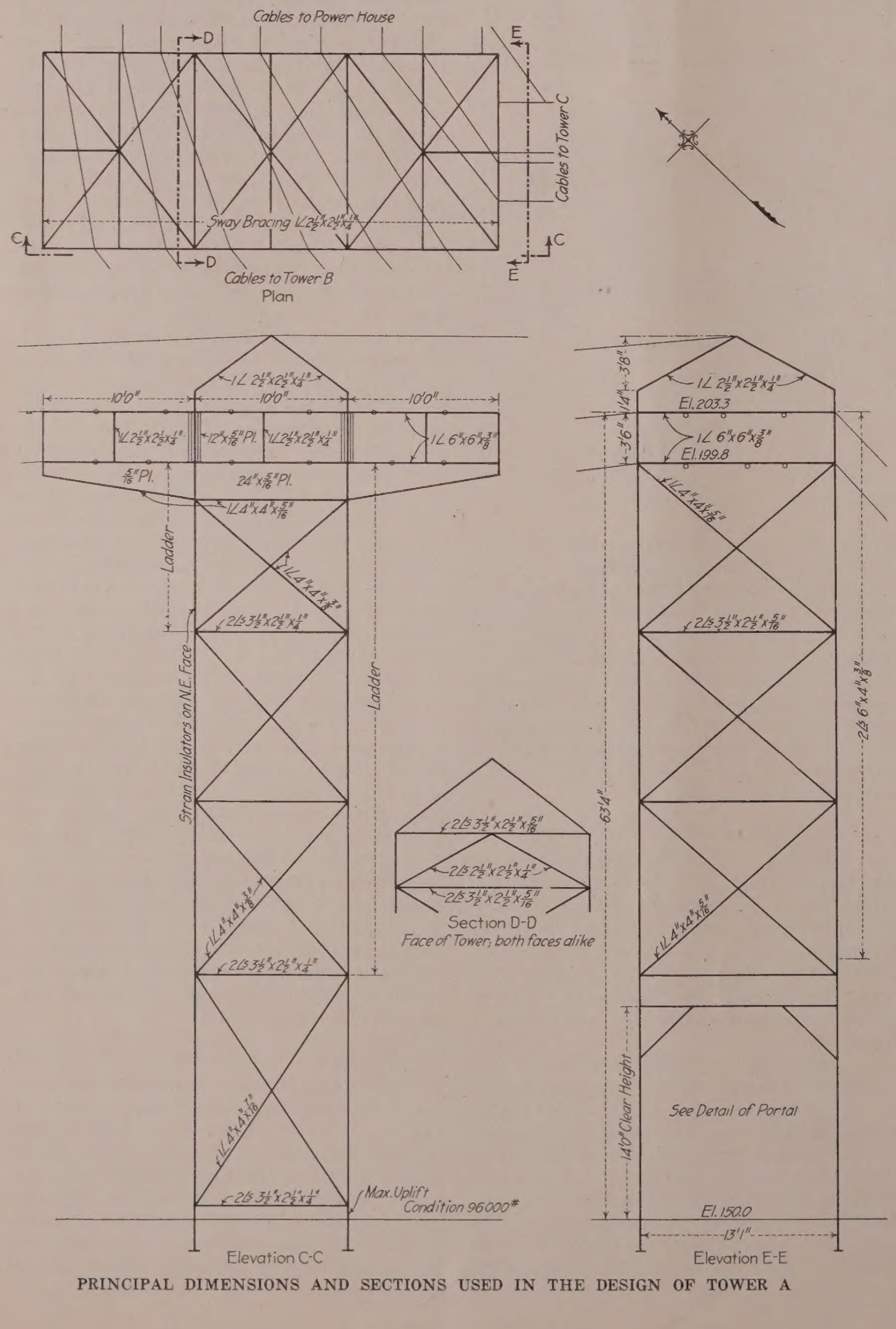
If the allowable stress be fully developed for the worst condition of lowest temperature, high wind and sleet coating it is possible to compute the resulting slope at the tower, or inclination of the reaction, by a formula in terms of this stress, given in the article above referred to. Thus $C = \tan^{-1} h/L + \sin^{-1} wL/2P$, in which $C$ is angle of inclination of end reaction; $h$, difference in end elevations; $L$, horizontal span length; $w$, load per foot, and $P$, total stress in cable at upper end. Then $H = P \cos C$.

It should be noted that when the cables are erected, usually at a relatively high temperature, there is no sleet load and corresponding cable elongation, and hence it is seldom considered necessary to compute accurately the effect of temperature difference to modify the sag at erection, as it is offset by the effect of change in length due to elastic strain under the heavier sleet and wind loads.

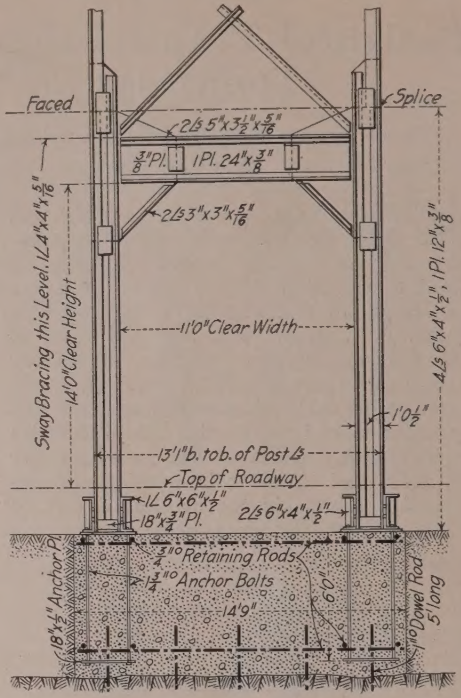
The above discussion and formulas are based on the assumption of a parabolic curve for the cable, as produced by a uniformly distributed horizontal loading. The loading is really uniform along the cable and the curve is a catenary, but the foregoing assumption is considered sufficiently exact, particularly in view of the great variation possible in the assumed thickness of ice coating.

### TORSION STRESSES—GENERAL DETAILS

The analysis for the condition of maximum torsion (Case 5) was made on the assumption that the horizontal sway bracing carried the shear to the tower planes, which developed the required reactions and transferred them vertically to the foundations by stresses in web members and columns. These stresses will exceed the stresses due to symmetrically applied loads on the cross arm because of the increase in the tower reaction on one side. In all stress analysis the diagonals were assumed to develop tension only and designed to transmit the whole shear in the panel.



PRINCIPAL DIMENSIONS AND SECTIONS USED IN THE DESIGN OF TOWER A



DETAILS OF PORTAL DESIGN—TOWER A

### PORTAL CONSTRUCTION

The resulting sections required and the details of the portal are shown in the accompanying drawings. Contrary to the usual practice in transmission-tower design, it is seen that the columns and struts are of relatively small length ratio and that a substantial construction throughout was provided.

The heavy concrete pedestals constructed with large anchor bolts and tie rods as shown are of special design and were fixed chiefly by local conditions and the limitations imposed by the presence of penstocks giving little width for foundations. The adoption of plate-girder portal construction to provide clearance for the roadway was influenced by the general requirement of rigidity. When the original outline was made the upper cross arm was built of open truss members, but it was found necessary to change to the plate-girder type, as used, in order to provide for the distribution of the many cables with the required clearance of 9 in. from all steel.

The required conditions for design and stress analysis were furnished by Sanderson & Porter, the designing and supervising engineers. Instead of allowing structural steel companies to design the towers according to the conditions, J. S. Branne, consulting engineer, New York City, was instructed to make the design and also furnish drawings in such detail that they could be used as shop drawings. The contract for furnishing the steelwork was let to the Lackawanna Bridge Company, and the towers were erected, using bolted connections, by the Cohoes Company.

# Imhoff Tanks and Sprinklers for Sewage of Brighton District, Rochester, New York

### Two-Storied Tank Is of Unusual Design, while Development of Power Requires High Degree of Detritus Removal

ROCHESTER, N. Y., through its city engineer's office, has developed an Imhoff tank of unusual design for the Brighton sewage disposal plant, bids for which were received April 14. It was desired to secure an unusually large sludge-storage capacity with minimum dimensions in width and depth, and at the same time to preserve such a slope for the bottom of the flowing-through chamber that settling matter will readily slide into the sludge-digestion compartment below. With unbroken slopes of the Imhoff baffles, the digestion chamber would have been reduced in volume or the most effective area of the flowing-through chamber undesirably diminished. The designer hit upon the idea of breaking up the slope in a way to retain the same inclination, yet increase the volume of the digestion chamber without encroaching on the most effective section of the upper story.

An additional feature of unusual character is the detritus tank, aimed to secure a high degree of removal in advance of the Imhoff tank and before passing the sewage through Pelton wheels, which will be operated under a 69-ft. head.

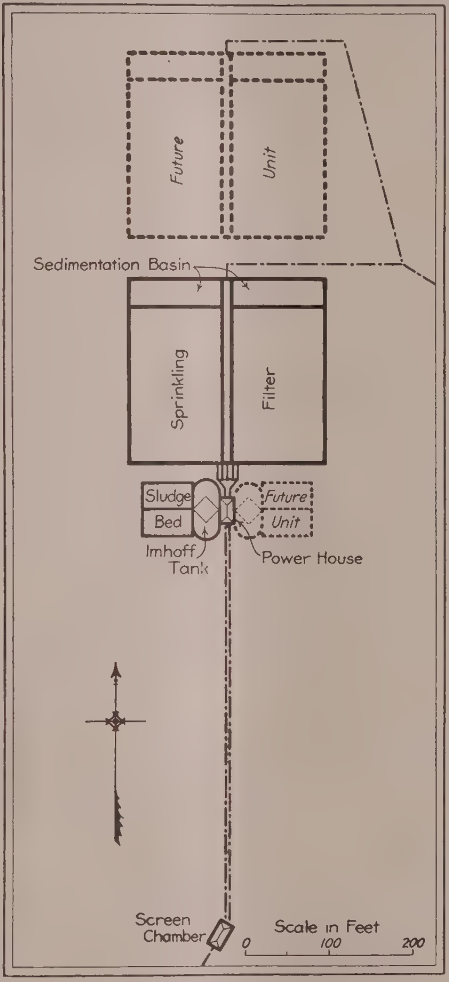
Besides the screening chamber and Imhoff tanks, there is a sludge-drying bed, a sprinkling filter and a final sedimentation basin, thus effecting a high degree of purification before discharge of the effluent into Irondequoit Creek, three-quarters of a mile from the head of Irondequoit Bay, an arm of Lake Ontario.

#### DISTRICT SERVED

The section of the city to be served by the new plant is the extreme northeastern part of Rochester, a district hitherto having a small population, but now increasing rapidly. The section, moreover, contains territory added to the city in recent years. Part of the section has been supplied with sewers and the discharge has been pumped into the East Side trunk sewer, thus finding its way to the Genesee River. By continuing this method of disposal, the sewage could, when the plant is completed, be brought to the main disposal plant, now being constructed near the shore of Lake Ontario. Even now, however, the pumping facilities are inadequate and with the rapid development of the district the operating charges under the pumping arrangement would exceed the operating, interest and other charges on a separate plant.

The site of the plant is a 22-acre tract in the extreme northeastern part of the Brighton district, splendidly secluded and so situated that it can have no deterrent effect upon the development of that part of the city.

At present the population of the district in question is in the neighborhood of 3000. Studies show that during 1915 a daily flow of not less than 1 cu. ft. per second must be expected, with an average of 1.20 cu. ft. and a possibility, for a few hours, of 2.30 cu. ft. The system is a separate one, but there are undoubtedly some surreptitious connections with roofs. It is estimated by the city engineer's office that with a population of 5000 the maximum amount of domestic sewage alone will be 500,000 gal. in 24 hours, and that with the same population the maximum domestic flow combined with the maximum wet weather infiltration will be about 2,000,000 gal. per day. The ultimate future population of the district is estimated at 25,000, and with this number it is estimated that the greatest amount of domestic sewage to be handled will be 2,500,000 gal. per day and of domestic sewage combined with wet weather infiltration, 5,000,000. It will be noted that the ratios of wet weather infiltration plus domestic sewage to domestic sewage alone are 4 to 1 in the one case and 2 to 1 in the other. This is due to the fact that much of the present infiltration comes from the Erie Canal, which will shortly be abandoned, and to the further fact that the filling up of the territory will not, to a great extent, increase the area from which infiltration comes. Moreover, the increasing number of storm-water sewers will lower the water table.



PLAN OF BRIGHTON SEWAGE DISPOSAL PLANT, ROCHESTER, NEW YORK

Drop of 75 ft. between screen chamber and power house allows 6 hp to be developed for each cubic foot of sewage.

For obvious reasons, screen and grit chambers are to be built at once for the final maximum population, but the remaining portions of the plant—the Imhoff tank, sludge-drying beds and sprinkling filters—are to be large enough for only 10,000 people, the remaining units to be built when required.

#### DETRITUS REMOVAL

Since coarse floating and suspended matter and heavy inorganic material, which will not digest and which makes sludge removal from the Imhoff tank more difficult, can be best removed as a preliminary to tank treatment, and because of the danger of foreign matter injuring the buckets of the Pelton wheels and clogging the nozzles, special care was given to the removal of detritus. Tests were made by discharging the sewage of the district (then having a population of about 1000) into a series of wire baskets with 1-in., ½-in., ¼-in., and ⅛-in. mesh. It was determined from this study that the wet screenings weighed 71 lb. per cubic foot and contained much coarse sand, that the loss of weight on drying was 20 per cent and that with the flow of 500,000 gal. for the 24 hours the amount of detritus and wet screenings collected was 4 cu. ft. This figure, too, is less than the actual amount carried, since the baskets clogged at times, allowing the sewage to splash over the sides and the lighter parts to be washed away. Much of this material, too, would not digest. It is assumed that with a population of 10,000, 40 cu. ft. a day must be provided for.

Herewith is a plan of the detritus and screen chamber. Entrance of the sewage will be through vertical baffles, the slats of which will be oval shaped, thus allowing the openings to be individually varied from 0 to 2¼ in. The slats can be clamped in whatever position is desired. In this manner it is proposed to secure a uniform distribution of flow over the width of the channel. The details are shown herewith.

The deep pocket in the forward end of each of the three channels is fitted with a false bottom, consisting of triangular-shaped wooden slats, 2 in. wide, spaced 1 in. apart. This floor will be hinged at the upstream end and free to move vertically at the downstream end, thus making it possible to decrease as desired the cross-sectional area between the false bottom and the scum board. By this means it is intended to control the velocity and the amount of deposition. With the floor as shown, 1 ft. below the spillway level, it is calculated that the velocity will vary from 0.21 ft. per second to 1.10 ft. per second with flows varying from 646,000 gal. per day to 5,000,000 gal. per day.

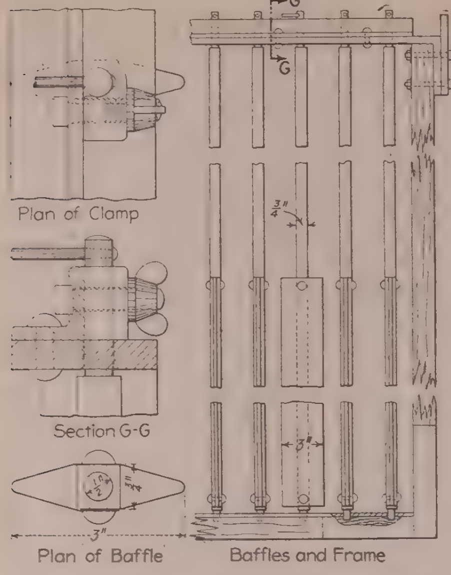
A steel skip beneath the false bottom will have a capacity of 1 cu. yd. and will be raised by a chain hoist on a traveling crane.

As a provision against rapid corrosion the screens are made of cast iron, 2 in. deep. The detail, shown in an illustration herewith, was worked out so that a rake with shallow teeth projecting between the bars could be used on the screen without striking the cross-bars.

As a provision against overflow in case the screens clog, emergency spillways are provided in the side walls of the channels leading directly to the effluent chamber.

All grooves and the sills for the support of screens and false bottoms are to be made of cast iron of heavy section in order to resist corrosion. The building will be fitted with a 3-ton traveling crane and heated with a hot-water system.

Under normal operation the effluent from



BAFFLES WITH VARIABLE OPENINGS

the screen chamber will discharge into a 16-in. cast-iron pipe line leading to the nozzles of the Pelton wheels in the power-house below. Should the wheels be shut down the effluent will back up in the cast-iron main and pass over the spillway in the end of the screen house to a 12-in. overflow pipe leading to the same chamber as the discharge from the wheels.

The head on the Pelton wheels will be 69 ft., and for each cubic foot of sewage it will be possible to develop 6 hp net. Each wheel will be belted to a 10-kw direct-current generator, and the resulting power will be used to run the cranes and light the plant.

### IMHOFF TANK

The novelty of the Imhoff tank lies not alone in the construction of the sloping bottom, referred to in the introduction to this article, but also in the combination of the circular shell and conical-bottom type with the rectangular and hopper-bottom type. The arrangement of beams and slabs for the false bottom gives a maximum area of settling channel and of sludge-digestion space for a given width and depth of tank. It also makes possible the use of thin slabs of uniform size and shape, cast at a convenient place and set when cured.

The sludge space provided is 1.84 cu. ft. per head, and this large allowance was made because during 120 days in the winter months at Rochester it may be impossible to remove and dry the sludge. This fact, too, necessarily influenced the size of the sludge-drying bed.

Allowing for a maximum variation of the level in the tank of 0.35 ft., the hydraulic features of the tank figure out as shown in the accompanying table.

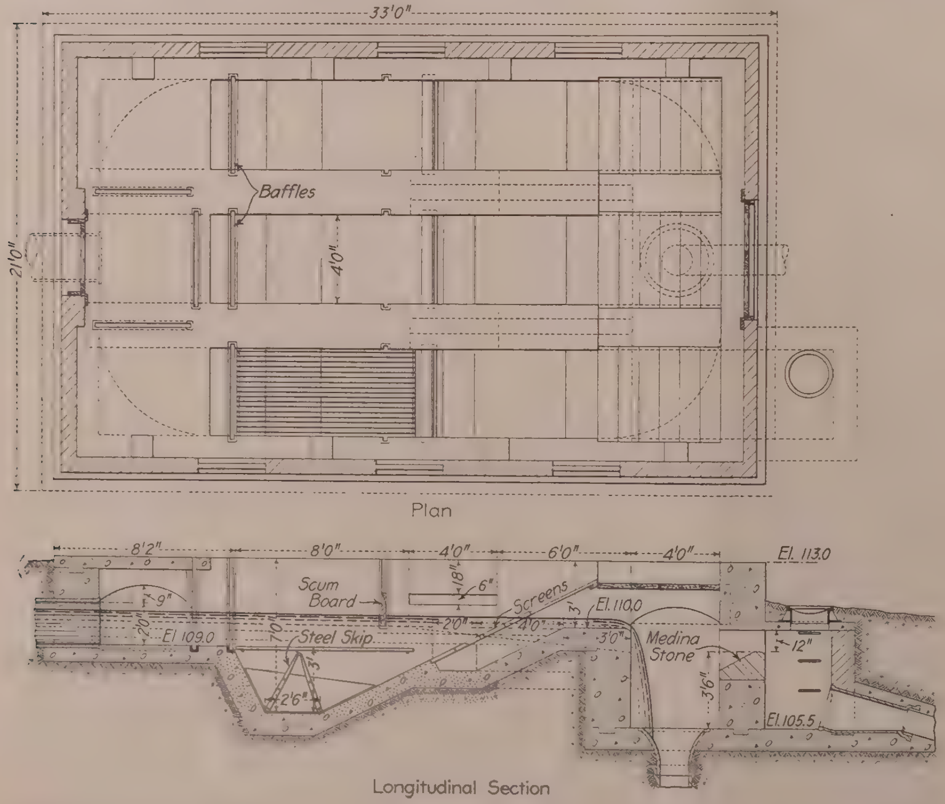
HYDRAULIC FEATURES OF BRIGHTON IMHOFF TANK

| Population in 1915 | Flow, gal. per day | | Flow Through Settling Channel: Duration, min. | Flow Through Settling Channel: Velocity in ft. per sec. |
|---|---|---|---|---|
| | Min. | 646,000 | 340 | 0.035 |
| | Mean | 776,000 | 283 | 0.042 |
| | Max. | 1,485,000 | 148 | 0.081 |
| 5,000 | | | | |
| | Mean | 1,100,000 | 200 | 0.060 |
| | Max. | 2,000,000 | 110 | 0.109 |
| 10,000 | | | | |
| | Mean | 1,800,000 | 122 | 0.098 |
| | Max. | 3,000,000 | 73 | 0.164 |

The details of the tank construction are clearly shown in accompanying drawings. It is proposed that the walls between the flowing-through, or settling, channel should be built of interlocking tile, 8 in. wide. The wall will be plastered on both sides with 1 in. of Portland-cement mortar placed in two coats. It is believed by the designer that this will give a rigid wall, amply tight and very light.

The reinforcing of the main walls is designed for maximum adverse conditions, that is to say, either with water inside the tank and earth pressure outside, or with tank empty and the surrounding ground saturated with water. The reinforcing is placed accordingly.

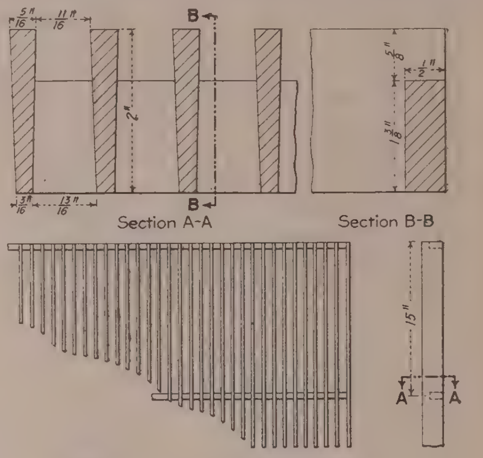
It will be noted that in the design of the false bottom the slopes are such as to shed deposited material readily and that the gas is properly trapped and led to the gas slot at the sides, which, it will also be noted, are of liberal area.



HIGH DEGREE OF DETRITUS REMOVAL EXPECTED IN THIS DETRITUS AND SCREEN CHAMBER

### SLUDGE-DRYING BED

The sludge-drying bed has net inside dimensions of 56 x 60 ft., divided by a center wall into halves which can be operated separately, the inflowing wet sludge being directed by means of gates to either half of the bed. The foundation of the bed will be a 6-in. layer of puddled clay, on which will be 6 in. of broken stone, 4 in. of sand and gravel and 2 in. of fine screened sand. The collecting laterals, of 2-in. drain tile laid with ¼-in. open joints, will be placed directly on the puddled clay. They are laid in transverse lines and discharge into a collecting pipe beneath the center wall. They are 8 ft. on centers and those adjoining the walls are 4 ft. from the wall line. The beds have a slope of 1 in 200 toward the outlet side and the same slope, from both directions, toward the center wall, thus insuring an even distribution of the sludge over the surface of the bed and also satisfactory velocities in the underdrains.



DETAILS OF CAST-IRON SCREENS

The area available, 3360 sq. ft., amounts to 1/3 sq. ft. per inhabitant (10,000 population). With the present information available, and the storage capacity necessary in the Imhoff tank, the designer believes this area per inhabitant desirable. Should experience indicate that either more or less is required, proper increase or reduction in sludge-drying area can be made when the plant is extended for a population of 25,000.

### ASSUMPTIONS FOR DESIGN

Under the assumption of 1.84 cu. ft. per head for 4 months, taken as a basis in designing the sludge-digestion chamber of the Imhoff tank, about 5.53 cu. ft. of sludge must be provided for per inhabitant per annum. If this be put on the drying bed in the 34 weeks of open weather and 2 weeks are allowed for drying, each dose will amount to 0.33 cu. ft. per head, and since one-third of a square foot is allowed per inhabitant in the design of the bed the depth of the sludge at each dose will be approximately 0.98 ft. If the sludge contains 80 per cent moisture when applied and in 2 weeks has drained to a 60-per cent moisture content the loss in volume will be 50 per cent. Every 2 weeks, therefore, during 8 months, approximately 0.49 cu. ft. would be removed per capita, giving for 10,000 population 3074 cu. yd. of removed material per annum. If the moisture be still further reduced to 20 per cent after dumping, the amount deposited will shrink to 1537 cu. yd. per year or about 1 acre-ft. This will be useful for filling around the plant.

### SPRINKLING FILTERS

The clarified sewage from the Imhoff tank will flow to a dosing chamber, provided with two 20-in. Miller siphons, each with a capacity of 5000 gal. per minute under a 2-ft. head. Operation will begin under a 4½-ft. head. Provision is made, however, for the building of four siphon discharge chambers, two to provide for future units. The pipe to supply these future units is shown on the drawings. This pipe will be laid in the gallery now, though not needed at present.

Two half-acre units will be constructed at present, one on either side of the central pipe gallery. The general features are shown on drawings herewith.

It is believed by the designer that the beds should receive not to exceed an average of 2,000,000 gal. per acre per day. One acre, therefore, will be constructed for a population of 10,000, furnishing an average quantity of sewage of 1,800,000 gal. per day. The adopted rate of application will give a flow of 1389 gal. per minute on each half-acre bed operating half the time, which amounts to 12.29 gal. per minute per sprinkler head and will require a hydrostatic head of ± 4.1 ft. With the greater head available the sprinkling period will shorten and the rest intervals increase. It is figured that 20 per cent of the total head will be lost in the piping and sprinkler heads, and the beds have been sloped accordingly to compensate for this loss and to equalize the operation at near and distant points in the bed.

Screw caps will be placed on the ends of the lateral distributors in order that these may be readily cleaned. As indicated in the drawing the laterals will be carried on piers 3 ft. high. The pipe will be 5-in. soil pipe, and 5 x 2-in. saddle-hub tees will be used for the connection between the lateral and the riser. The latter will be made from 2-in. double-hub soil pipe cut in two, making the length 2 ft. 7½ in. The Columbus sprinkler head will be used.

It will be noted that each lateral is independently controlled, so that only seven or eight heads need be thrown out of commission at one time for cleaning.

The underdrains will be ventilated at their upper ends and accessible at the lower, where they will not be collected, but will discharge individually into the sedimentation basin. Streams of water can be turned into the drains at the upstream end or they can be rodded, to keep them clean.

The filtering material will be dense limestone, between ¾ and 1½-in. in size, this size being selected in order to obtain a large surface of contact with voids of minimum size but of maximum total volume.

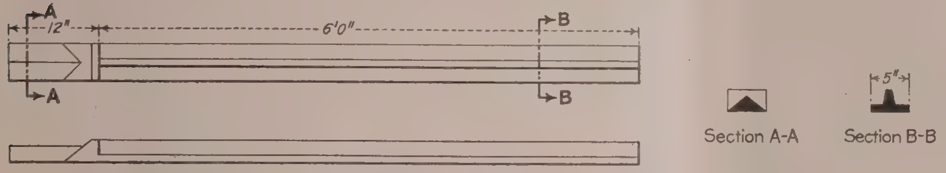
The maximum drainage required will be 15.6 cu. ft. per minute for any one drain under the maximum available head. Since a 6-in. tile on a 1 to 200 slope running half full has a capacity of 14.40 cu. ft. per minute with a corresponding velocity of 2.45 ft. per minute, the design provides double the capacity required, while at the same time maintaining a self-cleansing velocity in the underdrains. Alternative designs for the underdrain system, using a greater number of drains of the same size or of smaller size, were considered. With the same capacity and the same slope, however, the velocity would have been smaller and less certain of being self-cleansing.

### SEDIMENTATION BASINS

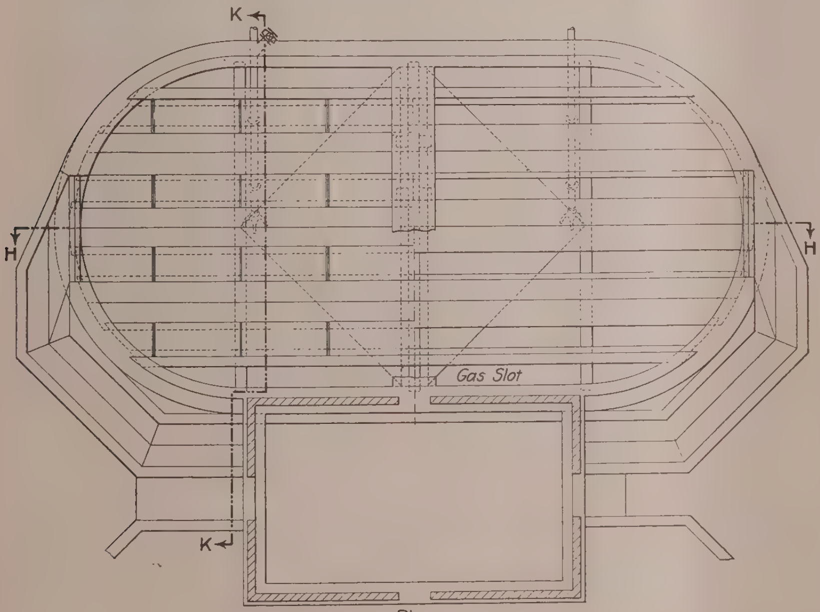
The sedimentation basins are built adjacent to the sprinkling filter. They have a capacity for two hours flow at mean discharge, or 75,000 gal. for each half acre bed. The discharge is under a curtain wall and over a weir in the operating gallery. If desired the basin can be drained through a 6-in. pipe, while any sediment that may accumulate can be squeegeed along the floor and through a sluice gate at the end away from the weir.

### ACKNOWLEDGMENTS

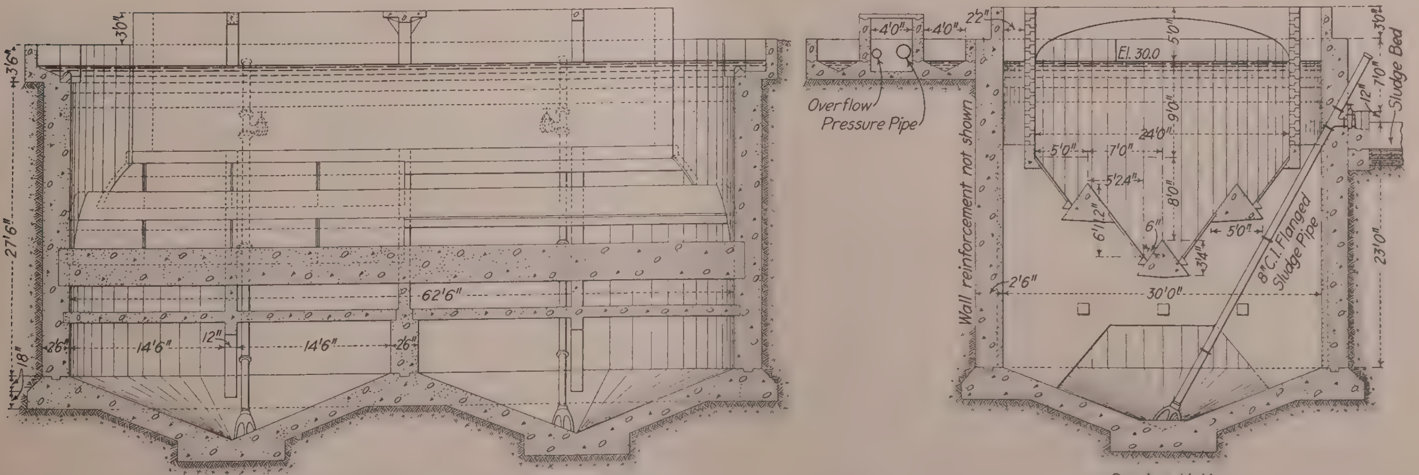
The general method of disposal was passed on by George C. Whipple, consulting engineer, of Harvard University, and his judgment was that with this treatment



CAST-IRON BEAMS SUPPORT BOTTOM SLABS OF SETTLING CHAMBERS



Plan

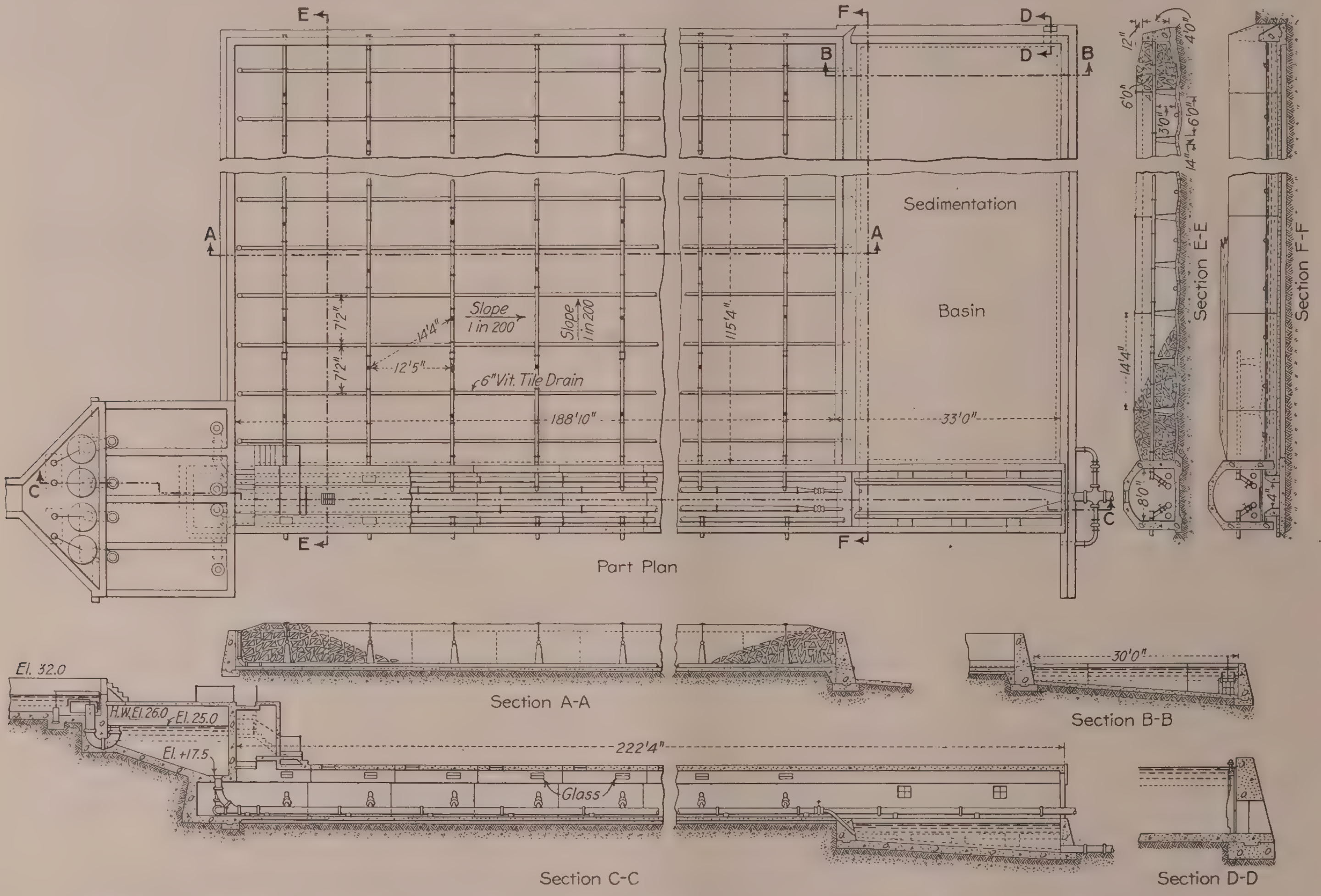


Section H-H

Section K-K

IMHOFF TANK HAS UNUSUAL FALSE BOTTOM, SECURING MAXIMUM EFFECTIVE AREAS IN DIGESTION AND FLOWING-THROUGH CHAMBERS no offensive conditions would occur in the stream receiving the discharge. Effluent from the sedimentation basins may be disinfected if desired.

The plant was designed by John F. Skinner, principal assistant engineer in the city engineer's office. The designs were subject to the approval of Frederick T. Elwood, now city engineer, and E. A. Fisher, consulting engineer. Bids for the construction were received April 14, the five lowest figures varying from $68,049.45 to $89,928.40. Assuming that not over 15 per cent of the present construction cost is on account of capacity to be needed in the future, the low bid would give a first cost, on the basis of 10,000 population, of $6.80 per inhabitant. In considering this figure it must be borne in mind that the plant is a small one and the degree of purification very high.



SPRINKLING FILTERS AND SEDIMENTATION BASIN—FILTER LATERALS ARE INDIVIDUALLY CONTROLLED, WHILE BOTH LATERALS AND DRAINS CAN READILY BE RODDED

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Highway Inspection Work in our Western States runs into considerable mileage, as is evidenced in the recent biennial report of the Colorado Highway Commission. T. J. Ehrhart, commissioner, and J. E. Maloney, State highway engineer, have traveled 46,000 miles by railroad and 17,000 miles by automobile the last two seasons. The automobile owned by the State averaged 8.9 cents per mile traveled. This cost included all expenses of maintenance, gasoline and repairs for the two seasons. As there were from one to four persons on these trips, the cost per person ran about 3 cents per mile per person, which is the same as the average railroad mileage.

# How the Government Makes Surveys for Local Use

Geo. Otis Smith, Director of Geological Survey, Explains Co-operative System Mutually Beneficial to Nation and Locality

SOME TIME AGO this journal received a complaint from a representative of a firm specializing in topographic engineering to the effect that the U. S. Geological Survey was entering into unfair competition with private engineers in making surveys for engineering projects. The specific complaint was that in Harris County, Texas, after the county had obtained bids from fourteen engineers or engineering firms for a topographic survey of the county to afford data in connection with drainage, the Government survey "butted in" with a proposition to do the work, using as bait a donation of $5000 and other inducements which removed all semblance to fair competition. The director of the Geological Survey, Geo. Otis Smith, was therefore asked to explain the policy of the survey in the matter, and his reply follows:

### Mutual Benefits of Co-operative Surveys

The Geological Survey is making a topographic map of the United States, which at present is approximately 40 per cent completed. In order to hasten the progress of this great undertaking the policy of making co-operative surveys was adopted early in the history of this organization.

What is meant by co-operation is the joint expenditure of public funds for public work in which the Federal survey and a State, or its legally constituted subdivisions, are mutually interested; and in every case the object of such co-operation has been to satisfy the demands of the public in contrast to private or individual interests. The requests for co-operative topographic surveys in all cases originate, not with the survey, but with the co-operating officials, and the the agreements are varied in detail to suit each special case.

The object of the State levee district, or county is to avail itself of the special facilities of the Federal survey, and thus to secure authoritative technical information in the form of a map which it is not equipped to make itself, and especially to insure completion of the work at an earlier date than would be possible with either appropriation alone. The object of the Geological Survey is to promote scientific investigation and engineering development of value to the people of the whole country and to expedite topographic mapping where the public interest is greatest.

### No Bonuses

It is true that the scale employed in making certain topographic maps under co-operative agreements is larger than is needed to satisfy the requirements of the Geological Survey alone, but it is equally true that the scale has a direct relation to the cost of the completed map of a given area; that is, all cost per square mile above the amount required to map the special area on a scale which fulfils the Federal survey requirements is borne by the State or county. Thus it will be seen that the resulting map costs the Federal survey no more than a map representing a survey on a smaller scale, while the State or county has a map which serves its specific purpose at a cost below that necessary to make the survey for its use alone.

It is therefore a misuse of terms to call the Federal contribution to co-operative topographic work a "bonus," since it represents the Geological Survey's interest in the topographic map of a given area.

### SYSTEM FIRST USED IN 1884

The co-operative policy outlined above was first put in practice in 1884 with the State of Massachusetts and was continued until that State was completely mapped. Since 1884 many other States have availed themselves of this policy, and during the current fiscal year nineteen States are co-operating with this survey in topographic mapping.

It should be borne in mind that the Geological Survey is not engaged in drainage or other construction work and does not prepare plans or estimates for engineering projects. State engineers, State geologists and other authorized co-operating officials have realized that the topographic map is the prime essential to a comprehensive study, not only of geologic and other scientific problems, but that it forms the base for the preliminary study of numerous types of industrial development, in addition to drainage reclamation. No class of the public more fully appreciates this fact than the engineering profession, which is one of the principal users of topographic maps and from which come a large number of requests for the surveys of new areas.

Of the many co-operative surveys similar to that authorized in the agreement with the officials of Harris County, Texas, may be mentioned the survey of the Kaskaskia, Embarrass, Big Muddy, and Spoon River valleys, in the State of Illinois; the Fifth Louisiana Levee District; the Tallahatchie Drainage District of Mississippi; the Sacramento and San Joaquin valleys of California; the Willamette River valley of Oregon, and numerous river profile surveys in Washington, Oregon and California, all of which provided the co-operating officials with base data for the use of engineers in the solution of reclamation problems and in the preparation of construction plans.

### THE HARRIS COUNTY CASE

Briefly, the history of the development of the co-operative agreement between the Geological Survey and the officials of Harris County, Texas, is as follows:

The Houston Chamber of Commerce in 1912 and again in 1914 brought the matter of the topographic survey of Harris County to the attention of her representative in Congress, urging co-operation between the county and the Federal Government. Hon. James M. Moore, then representing the Eighth Congressional District, transmitted the request to the Geological Survey on July 30, 1912, and on Nov. 5, 1914, his successor, Hon. Joe H. Eagle, renewed the request, in which the appropriation by the county was specifically mentioned. In 1912 and again in 1914 the policy of the Survey was explained to the Congressmen, and the basis of co-operation was stated as being that of proportional benefits, the contribution of the Federal survey in cases where such detailed surveys are desired as those in Harris County being directly related to the cost of making surveys on the usual standard mile-scale. In the discussion of this matter with Representative Eagle the question of the ability of this survey to furnish available funds during the present fiscal year was considered, and the tentative decision reached in February was that $5000 might be contributed by the Geological Survey, and at Representative Eagle's request the county officials were so informed.

The co-operation subsequently arranged with Harris County differs in no respect from the co-operation carried on, for instance, with the Fifth Louisiana Levee District in 1909, except in the sketching of intermediate contours and in the proportion of expense contributed by the Federal survey, which is considerably less under the Harris County agreement.

As stated in the beginning, Congress provides an annual appropriation for continuing the topographic survey of the United States, and to properly carry out this authorization the work must be planned and executed in a consistent and comprehensive manner in order that the survey of each individual area may finally become a component part of the completed map. The work must be referred to common standards, which if left to individuals or private concerns might be ignored and ultimately tend to costly duplication. Bearing this in mind, this survey feels not only warranted but compelled by a broad public policy, in large undertakings similar to the mapping of Harris County, an area of nearly 1700 sq. mi., to give all the assistance possible when so large a public interest is involved.

# Three Roofs Furnish More Dirt than 4¼ Miles of Street

This Surprising Discovery Is Made by Richard T. Fox of the Citizens' Street Cleaning Bureau of Chicago

DIRT and rubbish removed recently from the roofs of three of Chicago's downtown buildings, whose combined area was about 14,000 sq. ft., amounted to 29 cu. yd. This quantity, by way of comparison, is as much material as the Chicago Citizens' Street Cleaning Bureau collects in an entire day from 4¼ mi. of downtown streets. The roofs were cleaned by Aldes & Company, agents for the Marquette Building, whose tenants had complained of the dirt and fine dust that was blown into their offices from the roof of a large office building near by and the two small roofs adjoining it on the west. This case and many others were brought to light by recent investigations conducted by Richard T. Fox, of the Chicago Citizens' Street Cleaning Bureau. As the cleaning of roofs has considerable bearing on the thoroughness with which the streets can be kept clean, the bureau is endeavoring to get the Building Managers' Association to take some action and induce owners of buildings to clean their roofs at regular intervals or let the bureau do the work.

NOT A SAND DUNE—ONLY THE SWEEPINGS FROM A CHICAGO ROOF

ROOF ORNAMENTS THAT WERE NOT CALLED FOR IN THE SPECIFICATIONS

It has been suggested that all downtown roofs be cleaned at regular intervals and that they be sprinkled with oil or tar to hold the dust. Objection, however, was made to this on the score that it might affect in some way the guarantee on the roofs, increase the fire hazard, or damage the roofs in some way. The objection as to the fire hazard has been pointed out as being unfounded, inasmuch as the light oils, benzine, gasoline and other inflammables are extracted before the tar or oil is placed on the market.

The photographs shown herewith were taken by Dr. George B. Young, health commissioner of Chicago.

A "BREATHING PIPE" was described at the recent American Waterworks Association Convention by W. F. Wilcox, of Ensley, Ala. Fluctuations in pumping pressure caused a regular heaving of a 50-in. steel pipe line, amounting to 5/32 in., although the movement to those who watched the "respiration" of the pipe appeared much greater. The alternate flattening and expansion of the line caused a crack in the ground above for a length of 2 miles. An air chamber to take up the surge was installed and remedied the trouble.

# Experiences Gained from Reinforced-Concrete Barges Built for the Panama Canal

### Failures in 1911, Due to Use Not Anticipated in the Design, Do Not Prove Unsuitability of the Type—Extreme Care Needed in Launching

By W. ROWLAND
Assistant Engineer, Division of Terminal Construction, Panama Canal

IN THE INTRODUCTION to an article in Engineering Record of May 28, 1910, page 707, describing reinforced-concrete barges built by the Pacific Division of the Panama Canal, the following statement is made: "Builders of reinforced-concrete vessels are all in concord that reinforced concrete lends itself very well to this new use and under certain conditions, is even superior to wood or steel; such conditions caused the adoption of reinforced concrete as the material for the barges described herein." Three barges were built to carry the dredging pumps forming part of the plant used for hydraulic excavation at the site of Miraflores Locks and in the channel south of the same. They were launched April 20, June 18, and Aug. 8, 1910, respectively, and the first one was placed in service Sept. 5, 1910. Ten months later, in June, 1911, all three barges were destroyed. But is that to be interpreted as proof that concrete was not the proper material for these barges?

## DESIGN AND ORIGINAL PLAN OF OPERATION

Details of the barges are given in the accompanying drawings. A. P. Crary, who, under the direction of S. B. Williamson, division engineer, constructed them, made the statement that no barge, whether wood or steel, could have stood longer the hard punishment to which they were subjected. Everybody will agree with him after knowing how the barges were used.

The original plan for working the barges was to lower the water, by means of the dredge pumps mounted on them, in the area to be excavated until it was just deep enough to keep them afloat in the lowest parts, which were to form sumps for the suction pipes. Then the material in the sides and bottoms of the pits could be dislodged by the monitors and sluiced to the sumps, whence the dredge pumps would lift and carry it through pipe lines to the dumps. When the slopes of the pits became too flat for the sluicing of material, the giants were to cut new and deeper sumps with a channel leading into each, through which the barges could be floated to their new position.

With this method of operation the barges were expected to be afloat all the time. But to provide for emergencies they were designed to withstand the stress caused by being grounded near the two ends or at the center, with a reduction of 12 in. in the draft. It was the intention to stop pumping before the water in the sumps reached that mark and to wait until the inflow from the monitors raised the water level sufficiently to float the barges, when pumping was to be resumed.

## CHANGES IN OPERATION

Soon after operations began it was found that the sluicing was most effective when the pits were as nearly dry as possible. To obtain this favorable condition it became necessary to let the barges settle and to pump the mud-laden water as fast as it came into the small sumps which formed themselves and widened rapidly around the intakes by the powerful suction of the pumps. The intention was, of course, to have the barges rest on smooth and level ground, but this was extremely difficult on account of boulders, stumps and trunks of old trees which were found buried in the alluvial soil. Many times the barges could be seen high and dry, resting only on a few supports.

It was also proved that often it was not possible to cut, as intended, deeper sumps in new localities, and channels leading to them. In these cases the nozzles of the monitors were directed so as to wash the soil out from underneath the barges, thus gradually deepening the sumps and lowering them. In this process it was found that the jet dug holes and grooves, leaving points and ridges on which the barges rested until these elevated parts crumbled under the impact of the powerful streams and the weight of the barges, letting them drop suddenly. The result of this mode of operation was that the barges broke, the destruction taking place in these three different ways, depending on the way of stranding.

## THREE KINDS OF FAILURE

1. The bottom slab was punched by a tree stump or pointed boulder. A number of these breaks occurred and all have been successfully repaired by removing the concrete as far as the cracks extended, straightening the bent reinforcing bars and closing the opening with a rich concrete. These repairs could be made quickly, cost little and proved in most cases to be watertight.

2. The concrete of the deck was crushed in one case, where the sump was being dug directly under the middle of one of the barges so that it had to carry its own weight and all of the machinery over a span of about 50 ft. The concrete was so badly broken up that after releasing the stresses the pieces could be pulled out by hand from between the bars for a width of about 6 in. The cracks did not extend into the side slab nor did they show distinctly in the upper chords of the main trusses. It is remarkable that the bottom and side slabs were damaged so little that no leaks showed up. The deck was repaired and the barge had been in service for fully a month after the accident before she broke again at the same place.

3. The deck failed in tension. In this case the barge had settled on a ridge of boulders with both ends unsupported. A crack of about ⅛ in. opened over the full width of the barge and extended down into the side slabs for more than half of the height. The crack was not straight and did not run at right angles to the length of the barge, but intersected one cross frame and was visible clear through one cross beam near the corbel and through the upper chords of all trusses. None of the exposed bars were torn; apparently they had failed in bond and a few bars that ended near the crack had spalled off the concrete, showing plainly where they had slipped. No attempt was made to repair this barge. She had to be dynamited shortly afterward to get her out of the way.

The accident described under case 1 would have occurred to a wooden or steel barge under similar conditions, while breaks in cases 2 and 3 are peculiar to the concrete barges, since these failures are mostly due to their great weight. It must, however, be admitted that the barges could have been built to stand the stresses caused by their peculiar use, had that use been foreseen.

Analyzing the stresses under the conditions of loading at the time of the break, it is found that the bending moment in case 2 is 1,698,000 ft.lb., and in case 3 1,967,000 ft.lb. Assuming that the longitudinal trusses alone resisted these moments, the computed stresses were found so high that it became evident that the bottom and deck slab must have acted as chords of the trusses.

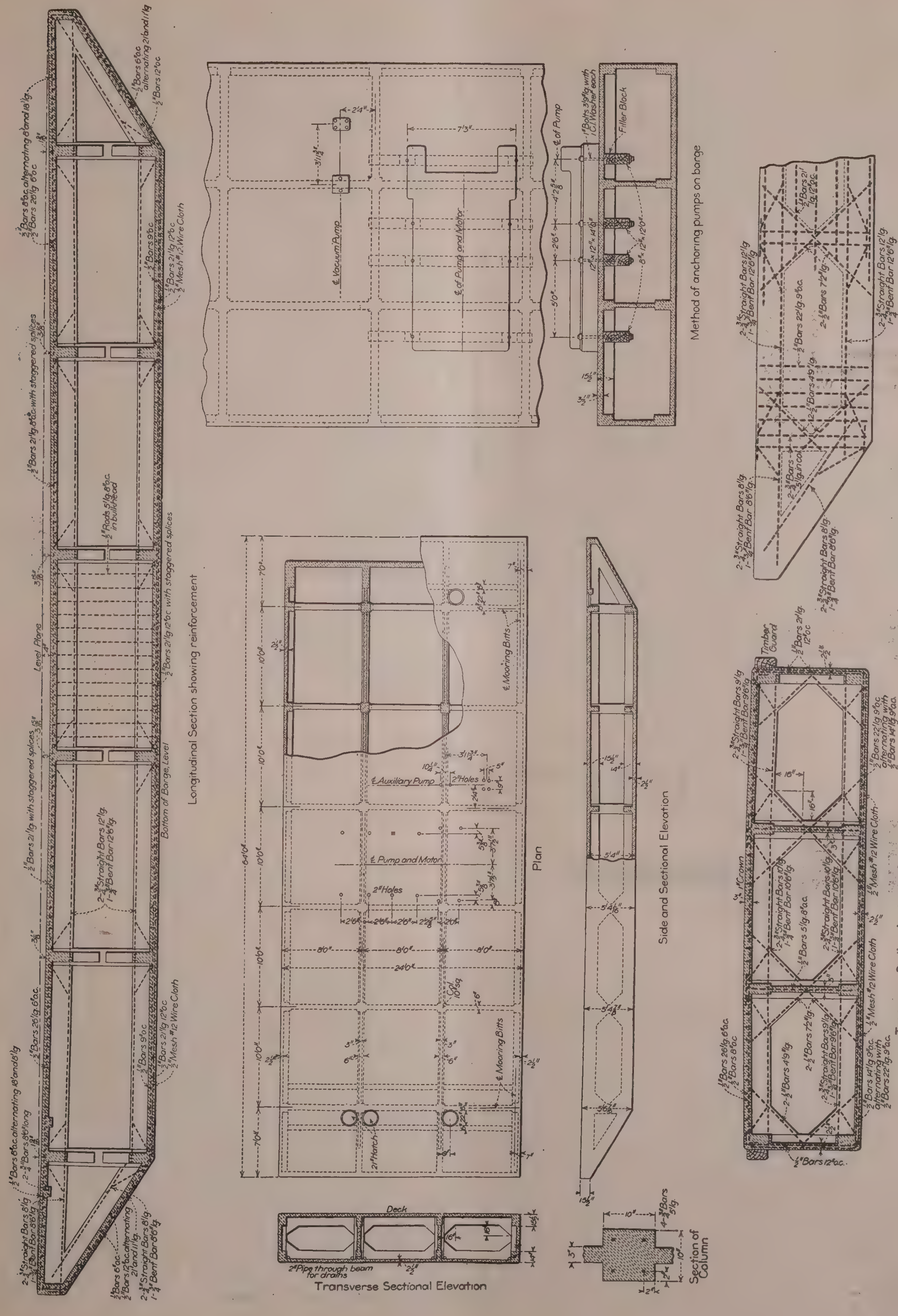
If it be assumed that all longitudinal bars on the tension side were stressed equally, the unit stress in case 2 was 31,000 lb. per square inch, and in case 3, 29,000 lb. These stresses the high-carbon steel resisted safely, but in the last case they were apparently too great to be transmitted by the splices of the reinforcing bars in the slab. These splices were made by overlapping 12 in. of the ½-in. x 21-ft. square bars, and were located over the cross beams where the slab as such required no reinforcement. But since the slab acted as the chord of the trusses, each splice had to transfer stresses of 7770 and 7250 lb. respectively, which required an average bond strength of 325 lb. per square inch in case 2 and 300 in case 3. These values are too high even for corrugated bars, and explain readily the failure on the tension side in case 3. That the same failure did not take place on the tension side in case 2 is because of the action of wire cloth placed in the bottom slab, which apparently covered effectively the weak splices of the slab bars.

The failure on the compression side is not so easily explained. In case 3 the concrete of the bottom slab, although it was plastered and not poured, resisted a compression of 410 lb. per square inch, while in case 2, with a computed stress of only 350 lb. per square inch, the concrete in the deck was crushed. It is probable that in case 3 the bars in the deck slipped when the bond stress passed 250 lb., and consequently the compression in the bottom slab never reached the value given above. On the other hand in case 2 the stress in the deck evidently was higher than computed.

## WIRE CLOTH PROVED EFFECTIVE

So far it has been assumed that the total slab acted as part of the trusses; apparently this assumption is not correct for the deck slab. The bottom slab contained beside the bar reinforcement, similar to that of the deck slab, a wire cloth of ½-in. mesh, No. 12. It is probable that this wire cloth, which was laid crosswise, distributed the stresses so well that the full width of the slab became effective as a compression chord. In the deck slab, however, the stresses were distributed only over such small part of the width that the unit stress reached the crushing value. It is also conceivable that the continuous vibrations caused by the pump and its motor decreased the strength of the concrete and partly broke the bond between the concrete and the reinforcing bars, which would further help to explain the way in which the barges failed.

This analysis shows that the design of the barges could have been improved by providing an efficient splice for the longitudinal



Longitudinal Section showing reinforcement

Plan

Transverse Sectional Elevation

Method of anchoring pumps on barge

Side and Sectional Elevation

Section of Column

Side Elevation showing reinforcement in Beams, Posts and Diagonals

Transverse Section showing reinforcement

DETAILS OF THE REINFORCED-CONCRETE BARGES CONSTRUCTED ON THE PACIFIC DIVISION OF THE PANAMA CANAL FOR CARRYING CENTRIFUGAL PUMPING UNITS bars in the deck and floor slab, and by using wire mesh in the deck as well as in the bottom.

After two of the barges had failed, well timbered sumps were sunk to about 5 ft. below the future bottom of the canal and the dredge pumps mounted alongside on concrete foundations, thus doing away with any need for the concrete barges, and this arrangement worked satisfactorily. This experience may be interpreted as proof that it was a mistake to provide floating supports for the pumps, but it certainly does not prove that reinforced concrete was not the proper material for these barges, since it has been demonstrated that it is possible to use reinforced concrete for floating structures under the most trying conditions, if they be properly designed.

### FAILURE OF A FOURTH BARGE AT THE TIME OF LAUNCHING

In September, 1910, a fourth barge was built in the shipyards at Balboa as an experiment. While the overall dimensions were the same as those of the other barges, the sizes of slabs, beams and bulkheads were reduced to a minimum, so that the barge drew 9 in. less than her predecessors. It is to be regretted that no records have been kept of her dimensions. Even her fender and her mooring bitts were made of concrete.

While the barges built at Miraflores had been launched sideways, this last one was launched lengthways on account of crowded conditions in Balboa. The ways, originally built for light steel barges, gave way under the great weight at the launching, and the barge broke in two. She was pulled out right away, and the crack, which went clear around, was calked; but she kept on leaking and finally had to be abandoned for that reason.

This barge has been in use about six months for carrying building material to the fortifications and heavy repair parts to the dredges. She was so hard to tow on account of her great draft that towboat men would avoid towing her wherever possible. In a number of unavoidable collisions with other barges and tugs the concrete fender proved to be absolutely inadequate to absorb impact. One mooring bitt was ripped off entirely, the deck was punctured by dropping heavy castings, and one corner was sheared off nearly to the water line by being rammed by a tug. It was remarkable, however, with what ease all defects could be repaired. A few sacks of cement and sand were always kept aboard for that purpose, and most of the patching was done while on the way. In nearly all cases a perfect bond between old and new concrete was obtained.

When interviewed W. G. Comber, in charge of the dredging division, gave the following opinion on the serviceability of these concrete barges: "The first three barges built for and put to an exceptional use do not very well allow us to draw conclusions applicable to ordinary cases. The fourth proved that reinforced concrete is cheaper than wood or steel for barges of this size and under conditions of labor and material supply as they exist on the Isthmus. Concrete barges give satisfactory service provided there is not too much towing to be done; for landing stages, wharf boats and floats that are moored permanently at a given point in quiet waters, especially in sea water, I should regard a concrete barge as being well suited, mainly on account of its small initial and maintenance cost. But builders should realize that concrete barges, more than any others, need a heavy wooden fender, and not too much care can be taken in launching."

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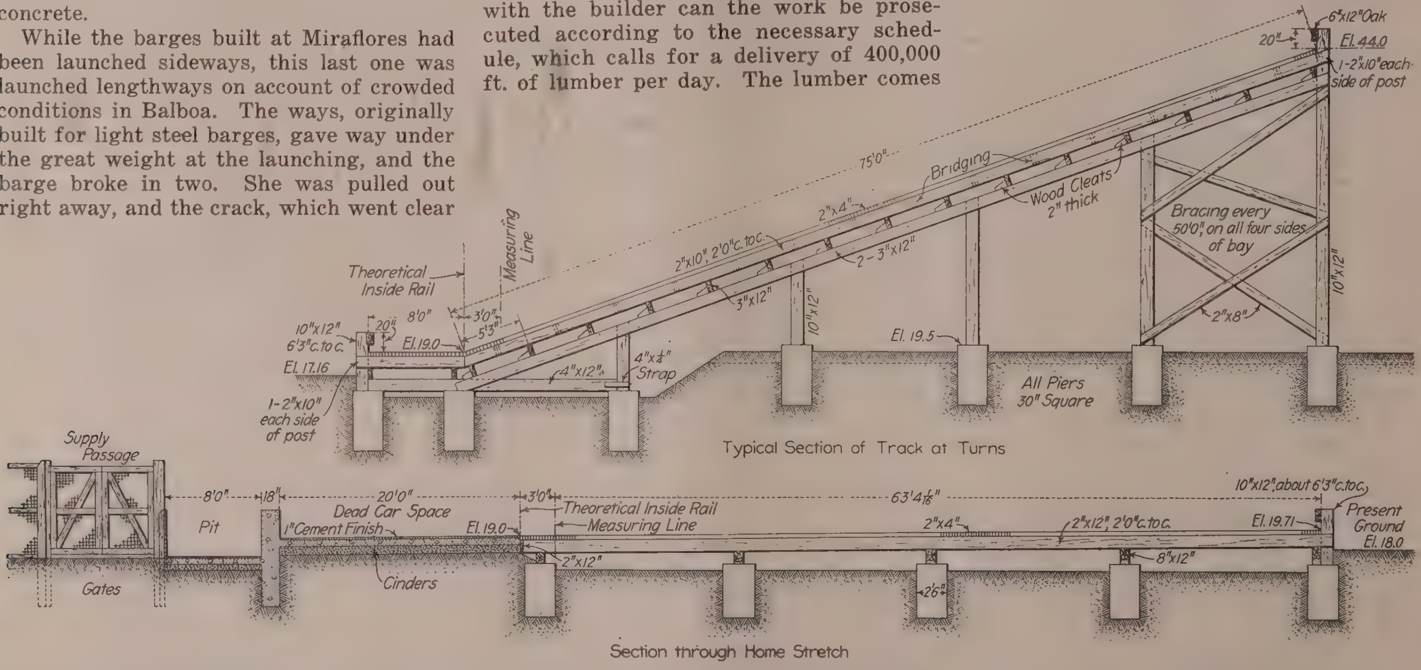
# Building a Two-Mile Speedway in Six Weeks

### Laminated Wood Floor and Supports Involve 9,000,000 Feet of Lumber, Largest Single Order Ever Let in Chicago

A TWO-MILE, million-dollar automobile speedway with a laminated wood flooring and timber supports on 7500 concrete piers is being rushed to completion near Maywood, just west of Chicago, so that races may take place June 19. The track contract, which involves 9,000,000 ft. of lumber and 12,000 cu. yd. of concrete, is to be completed by June 1, six weeks after the contract was signed. Only through thorough co-operation of the material men with the builder can the work be prosecuted according to the necessary schedule, which calls for a delivery of 400,000 ft. of lumber per day. The lumber comes from the Edward Hines Lumber Company yards on Blue Island Avenue, 9 miles from the track, and is being hauled on all kinds of horse and auto trucks carrying from 4000 to 12,000 ft. Four sand and gravel companies have their equipment at work getting the concrete aggregate to the job. From the first day the contractor has had a repair gang constantly at work to enable the heavy trucks to pass over the macadam roads which lead to and surround the property.

### DESIGN A DISTORTED OVAL

The speedway track is 2 miles in length and of a general oval form with tangents on the home and back stretch connected at the north turn by 800-ft. spirals with a circular arc of 988-ft. radius, and at the south turn by spirals of greater length, both reversed about an axis, with a circular arc of 1313-ft. radius. This gives a distorted or unsymmetrical curvature to the turn, made necessary by the shape of the property, the south line along the railroad being oblique to the east and west lines, and the length insufficient to permit laying out a 2-mile track without forcing it into the acute angle at the south end.



CROSS-SECTIONS OF THE MAYWOOD SPEEDWAY TRACK ON THE HOME STRETCH AND AT ONE OF THE TURNS

In dealing with superelevation, or transverse inclination of the track on turns, the inclination for the curve of the north turn was designed for a 25-ft. rise in 70 ft. 8½ in. horizontal, corresponding to a theoretical speed of between 70 and 75 miles per hour. This slope was taken as the greatest inclination allowable without danger to a car obliged to slow down on the curve. The above inclination holds constant on the circular arc of the north turn and is connected with the level track on the tangent by a warped surface having an even grade of about 3 per cent at the outer rail and a level grade at the measuring line. The 3-per cent grade at the outer rail occurs wholly within the limits of the 800-ft. spiral, the variation of superelevation thus corresponding to the variation of curvature in the spiral in transition from tangent to curve or vice versa.

The south turn was handled in a similar

manner, the grade on the first 800 ft. of each spiral being identical with that on the north turn. Beyond this end of the spiral the track at the outer rail was run level at superelevation of 25 ft. over the central portion of the reversed spirals, disregarding the increasing curvature. It was then run down on the same grade to a superelevation of 19 ft. and kept constant over the circular arc of the south turn corresponding to approximately the same speed as the 25-ft. elevation on the arc of the north turn. The curvature of the central portion of the reversed spirals exceeds that of the circular arc of the north turn, but this was disregarded and an inclination identical with that of the north turn was used, as a greater slope was thought to involve danger to a car obliged to slow down while on the turn.

The 3-per cent grades at the outer rail are eased into the level grades at both top and bottom by vertical curves about 75 ft. in length. On the back stretch the track is 60 ft. wide, on the turns it is 80 ft., and in front of the grandstand on the home stretch it is 70 ft.

### SURFACE OF TAMARACK

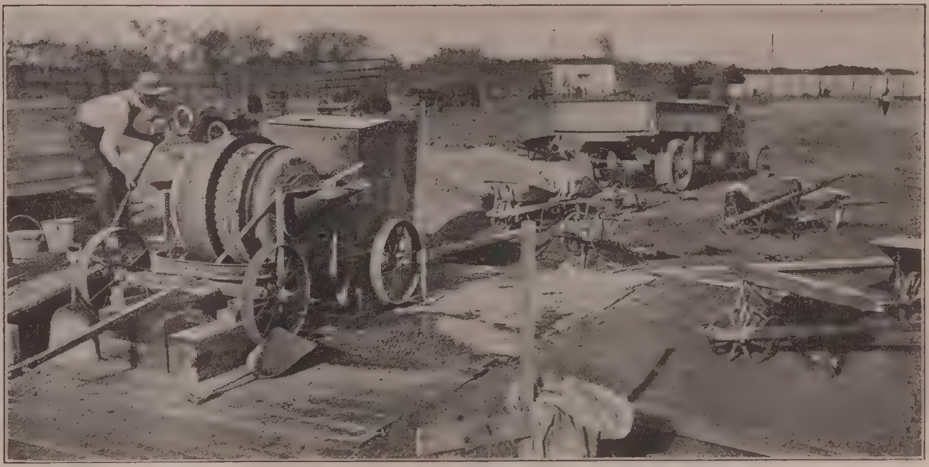
On the tangents the foundation for the track consists of five lines of concrete piers 30 in. square and 4 ft. deep. The longitudinal spacing varies from 12½ to 14 ft. Over the piers, which project about 6 in. above the surface, are placed 8 x 12-in. longitudinal sills, which in turn support 2 x 12-in. joists spaced on 2-ft. centers. The laminated floor consists of 2 x 4-in. tamarack scantling laid on edge. This floor required 4,000,000 ft. of lumber. All the remainder of the timber is of yellow pine. While the timber floor is considered cooler on tires, speedier than one of hard material, and more quickly built, the contractor states that it will also be more expensive.

The 6 x 12-in. oak guard rail is bolted to 10 x 12-in. posts spaced about 6½ ft. apart. Eight feet inside of the rail is the theoretical inside of the track and 3 ft. inside of this line is the measuring line. The 8-ft. width forming the dead space is flat on the curves.

On the turns the piers support 10 x 12-in. posts on which rest transverse inclined sills consisting of two 3 x 12-in. planks. Over the sills are 3 x 12-in. stringers normal to the sills, with 2 x 6-in. cleats on the lower side. Above the stringers, which are spaced on 5-ft. 3-in. centers, the construction with 2 x 10-in. joists and tamarack flooring is the same as on the tangents. Diagonal cross bracing is used between the high posts at the rear of the bents.

At the four corners of the property are subways under the turns to the area inside the track. These subways have four 7½-ft. macadamized roadways with 9 ft. headway and sidewalks on each side. An innovation at the main entrance, where there are ten ticket offices with entrances on each side and five automobile entrances each 16 ft. wide, consists of a bridge over the latter to permit an inspector to look down into vehicles and prevent smuggling in of passengers.

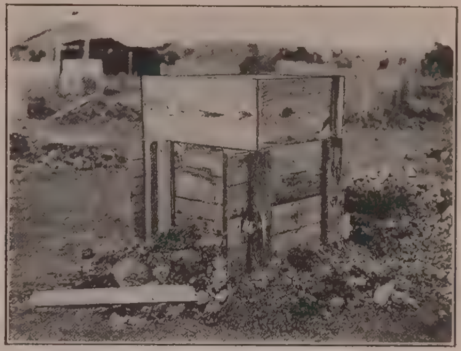
Plans are under way for bleachers seating 25,000 people lining the back stretch, and a grandstand and private boxes for 35,000 people on the home stretch facing the forty repair pits.



MOTOR TRUCKS DELIVER AGGREGATE TO 6-CUBIC FOOT MIXER

### WHOLE SURFACE SEWERED

One of the first tasks of the contractor was to construct the drainage system, which consists of parallel rows of 6-in. drain tile 200 ft. apart, leading to a trunk drain running diagonally through the property and finally discharging through a 30-in. line into the Des Plaines River, 1500 ft. beyond the property line.

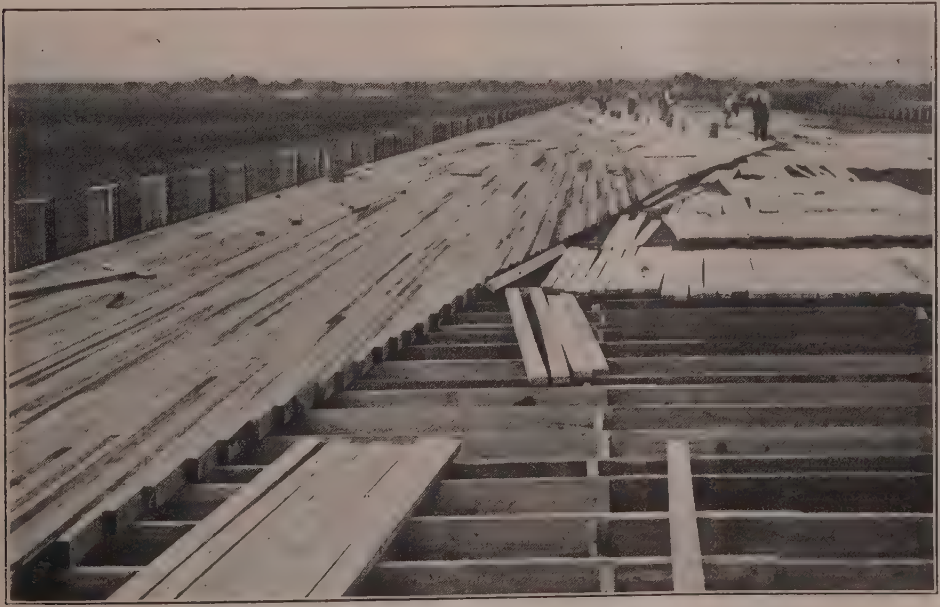


COLLAPSIBLE FORM WITH CATCH AND HASP FOR 7500 PIERS

On account of the extended character of the concrete work (the piers average 1 cu. yd. each) the contractor is using a number of small 6-cu. ft. Chain Belt gasoline-driven mixers. Planks are laid for the wheelers along each row of piers, and the mounted mixers are moved by hand twice each shift. The stations are about 200 ft. long. Within two weeks after starting work the contractor was working three shifts, light being provided at night by forty Prest-O-Lite torches on tripods 12 ft. high, which enable men to work within 500 ft.

At the start 500 men were employed, but gradually the number was increased to about 1200, as the job was so spread out that it permitted work to be started simultaneously at a number of points.

The Shank Company is building the speedway for the Speedway Park Association. Graham, Burnham & Company made the designs.



LAYING THE LAMINATED FLOORING ON THE MAYWOOD SPEEDWAY

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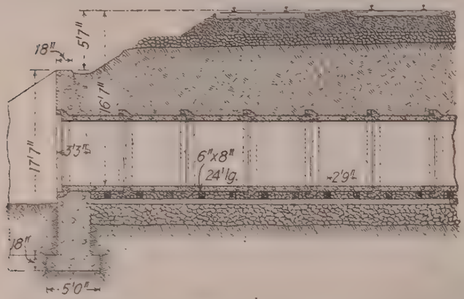
THE DESTRUCTIVE EFFECT of heavy wagon loads carried on narrow tires and its seriousness in the upkeep of the roads are called attention to by the State Highway Commission of Colorado in its recent biennial report. It is also pointed out that any method leading to the adoption of a law for a maximum load per inch of tire, not to exceed, says, 500 lb., would result in a large saving in maintenance. The report contains a number of pages devoted to the width of tires and contains the practice of various States and foreign countries. There is also included comment on the subject by well known authorities, covering a range of years.

# Reinforced-Concrete Pipes Replace Girder Bridge

### Three 6-Foot Lines Form Satisfactory Substitute for Steel Structure on Pennsylvania Railroad near Newport, Delaware

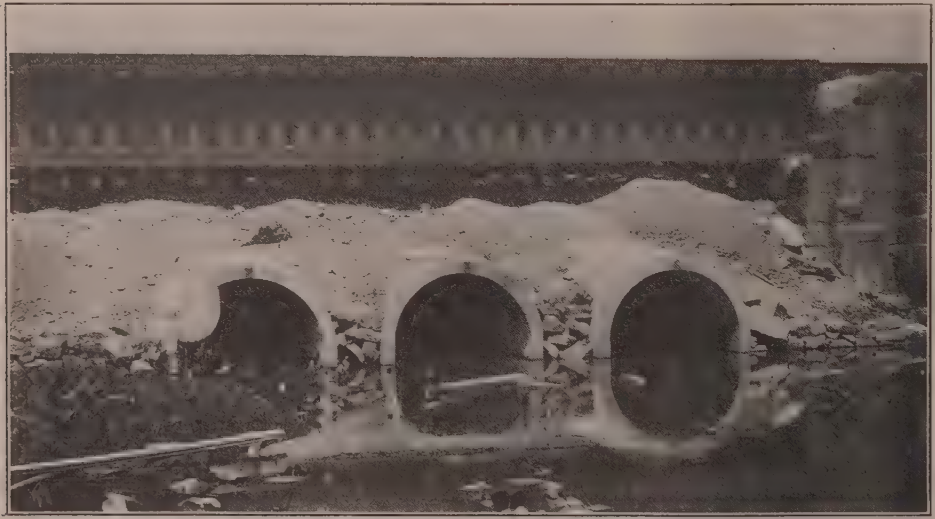
THREE lines of reinforced-concrete pipe with an inside diameter of about 6 ft. were installed some time ago to replace a three-track deck plate-girder span on the Maryland division of the Pennsylvania Railroad near Newport, Del. The stream is a tidal estuary with no appreciable current and little ordinary variation in water level. The bottom consisted of about 7 ft. of silt and mud underlain with sand and gravel stratified in varying degrees of coarseness to an indefinite depth.



DETAILS OF CULVERT FOUNDATION

In laying the pipe the water was sluiced around either side of the proposed location of the pipes. The mud and silt were then removed over the entire area to a depth of 2 ft., the excavated area was filled with quarry spalls, a solid mattress of old ties was laid thereon and across the mattress 6 x 8-in. stringers of Georgia pine 24 ft. long were spiked to the mattress, so spaced that the two stringers form a bearing for each length of pipe. The space between stringers was firmly packed with quarry spalls.

The pipes were unloaded by derrick from the outside track and skidded into position, and the joints were cemented up. The concrete end and wing walls at the west end were then constructed and the filling in was proceeded with. It is stated that there was no settlement or cracking in the pipes, and that the culverts, which have now been in place about two years, have remained in perfect condition.



THREE LINES OF REINFORCED-CONCRETE PIPE REPLACE STEEL BRIDGE

The drawing shows an end wall. The photograph, taken from the opposite side, shows no such wall. Owing to the likelihood of an additional track on this side no end wall was built.

The concrete pipe was furnished by the C. F. Massey Company, of Chicago. As previously stated the interior diameter is about 6 ft. A distinctive feature of this make of pipe is that it has a slightly elliptical cross-section, with circular reinforcement that comes near the inner circumference at the ends of the long diameter and near the outer circumference at the midpoints. Thus by placing the pipe with the long diameter vertical the reinforcement comes where it is most needed, and the visible elongation (6 in. in this case) makes it possible to do so, as could not be done if the pipe were circular. The thickness of the pipe shell is 6 in. and the total length of each section, including bell, is 6 ft. 4⅝ in., the effective length being 6 ft.

The work was done under the direction of the principal assistant engineer of the Philadelphia, Baltimore & Washington Railroad.

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# Education for Professional Success

### Young Engineer Should Exercise Greatest Care in Selecting First Work, Which Should Be Considered an Apprenticeship

By STERLING H. BUNNELL
Consulting Mechanical Engineer, New York

PRACTICAL LIFE sets up standards entirely different from those of the school and college, and the preparation necessary for success by their criteria is of a kind that cannot be obtained in school. Consequently a period of training—apprenticeship, in fact, if not in name—must follow graduation. The young engineer's first work, then, is of the greatest importance. It should give him a point of view from which some of the many roads to success can be seen, and its selection should be determined not by the starting salary offered but with regard to the character of apprenticeship it will afford.

In order to understand the present status of our technical colleges a few words will be said on the development of our school system. It has a direct bearing on the degree of preparation of our technical graduates.

### Characteristics of School System

The distinctive feature of the original school system of the United States, as compared with that of Germany in particular, and to some extent with the systems in other countries, is that it was planned along a purely academic line. The common schools, based on the "three R's," were continued in the direction of the entrance requirements of the classical colleges. The most fortunate students went over the whole route to the college diploma, to become ministers, lawyers or doctors after further study. Other students dropped off along the line and went into business or trades, while many, forced by press of circumstances, closed their school days in the district or common school, and went to work equipped only by an unfinished education, planned without study of its suitability for their several needs.

From this condition, much progress has already been made toward specialized educational facilities for every requirement. There is, however, no general system of correlation between the various institutions of learning. The prospective student has presented for his choice a bewildering number of schools and colleges, hardly any two agreeing even on the fundamentals. Some courses of study are based principally on the idea of mental drill; others are planned for the direct practical application of the subjects studied to trade or professional work, and still others are arranged with the intent of teaching something of the practice of a trade or profession, in the belief that graduates can thus be fitted to begin immediately to earn full wages for their work.

### Supplemental Training Necessary

It is certain that ten men of different characteristics taking technical courses in ten different schools will graduate each with a different preparation for technical work. It is quite possible that the best combination of man and course of study will not have been made in any case, and that if the men could be rearranged among the different schools, the result might be ten better-prepared men. Even with any possible assignment, a given man might not receive the training which would give him maximum efficiency, but would be better trained in some subjects than in others. To make up for such deficiencies, supplemental training is necessary, and this will differ for each individual. No school dealing with young men in large numbers can successfully undertake to make the most out of every one, or to analyze the abilities of each student and supplement each deficiency by special training. With a unified system of education and technical training, so that all graduates of technical schools would be everywhere measured by the same standards appropriate to their particular branch of education, the problem of adding to the standard course of study the particular supplementary training needed to strengthen the weak points of each student would be greatly simplified. But even under ideal conditions, there would still be such a problem. The solution must finally rest with the individual himself, to be worked out by his own careful consideration, with the help of all the advice obtainable from instructors and well-informed friends of mature years and experience; and finally to be checked by the trial and error method, correcting early mistakes as they become evident.

The supplemental training which is necessary to fit the technical graduate for conspicuous success in professional life is not to be obtained in graduate schools or universities, but in practical work under self-supporting conditions. The necessary understanding of the fundamental conditions which must be met by the man successful in the work of the world cannot be obtained in school. In spite of the attention now given by college faculties to placing experienced engineers, chemists, physicians and technologists at the head of the courses of study, the atmosphere and environment of college life cannot be made to resemble or illustrate the conditions under which the graduate must win his later success. Just as in an era of less general education, trade apprenticeship followed the few months or years of school life, so in the present time of educational advantages for the many, a virtual apprenticeship under a successful man, or in an efficient organization, should follow the technical school course. The first few years' work in subordinate positions is, in fact, a professional apprenticeship, and should be so regarded.

### CHOICE OF FIRST POSITION

To make a wise choice of his first "apprenticeship," the student should begin in his schooldays to observe the qualifications necessary for success in the various special lines into which practical technology may be divided. Machine design, for instance, the line which seems to be open for every student draftsman, is a specialty in which but few of the many draftsmen excel, and is poorly paid because of the number who attempt it without special aptitude. To be successful as a designer of machinery, one must make machine forms a constant study, so as to know and equal the best, and also to become familiar with every detail of molding, forging, machining or otherwise producing the parts of machines. The technical graduate knows how to calculate sizes and strengths; but exact science is of less value than the ability to design parts just stiff and strong enough for their purpose without calculation, and to check figures by known facts. Even in the drafting room, therefore, the man just out of college has little earning power at first; but if his choice is to become a designer of machinery, the value of the practical education he will obtain makes up for the small wages.

Similar conditions exist in all other technical specialties. The superintendent of construction must know how to use drawings, order and get needed materials, and handle the local workmen, none of which matters are taught in schools. The engineering salesman must know the possibilities of usefulness of every device he has in his data books, and be able to calculate the value of the production or saving they can make; and also, he must learn the difficult process of thinking from the other man's viewpoint, and finding out the particular sticking-point which holds back the signing of the order. The shop manager must learn the details of all his manufacturing methods, and the intricacies of getting everything ready just at the instant it is wanted, so as to have no unnecessary capital tied up in idle materials and parts. The financial head of a concern engaged in technical lines, acting as the connecting link between men who know little of technical processes and men who know little of finance must be almost an expert on both sides. And so with every other specialty into which men with technical knowledge work their way, the faculties and experience on which earning power is based must be acquired after the college course is finished, by real practical work.

### RELATION OF INCOME TO KIND OF WORK

But there is another quality more important to success than any amount of technical and practical knowledge, and entirely outside of the scope of the student's conception. The direct purpose in school life is to perform certain tasks correctly according to established standards; that is, to pass examinations. The purpose of working life is to obtain a satisfactory income, and here the task must be performed without any standards at all. Earning power is not closely dependent on long or short working hours, city or country life, or more or less recreation and diversion. Some men working five hours per day are well worth $10,000 salaries, because such men are capable of finding a way to obtain a market for the work of thousands of others. A man of such broad ability, finding himself without work, will immediately turn his attention to the field of opportunity, and develop another idea or plan that will afford many men a living, and bring him large returns. A wage-worker, on the contrary, when out of employment, generally has not the slightest idea of discovering some unusual job that needs doing, or showing some other man how to pay his wages out of savings or profits resulting from his work.

Among the few men in humble circumstances who do have the instinct of getting business are the Irish laborers who start on dump-carts and finish as wealthy contractors; the Italian concrete mixers who become builders, and then owners of magnificent apartment houses; the French cooks who go from hotel kitchens to managers' and owners' offices—and even yet, some men American-born and "self-made." Success in business life is not generally handed to one in salary increases, but must be gone after and got. The difference between men in their grasp of the situation shows up in times of depression. Then, the employees take care to come punctually to work and hope that their jobs are secure; but the president sits up nights, hustles for the money to meet the payroll, and gets the impossible big order that saves the day for the rest.

### MOST IMPORTANT OBJECT OF EARLY WORK

The viewpoint from which some of the many roads to success can be seen is then the most important thing which the technical graduate must acquire in his first years of practical work. His education is nothing more than a set of tools, which he must first learn to put to practical use. He can, for instance, already estimate the weights of projected work by mensuration and arithmetic, but he must yet learn how to use figures to allow for the swell on heavy castings, the mill extra weights on plates and bars, and the necessary allowance for the tendency of metal constructions to run heavier than the original figures. The great practical problem all the time is how to get clients or customers who will pay enough money to permit of doing work adequate to their requirements; and the next in order is to do the work with a safe margin for contingencies. The training which will fit the young man to handle these problems must be gained by working with successful men.

If a word of advice is to be given with regard to the character of the work which will afford the best practical apprenticeship to the technical graduate, it would be that he should make his own choice, and on considerations other than the starting wages offered. By all means the first work should be done with a strong, successful company. A little drafting, some estimating, a term in the accounting department, and a good long try at selling, with continuous and careful attention to both his work and the increase of his acquaintance with successful men, may be suggested as an outline of the scheme covering four or five years. Each kind of work attempted should be continued after it ceases to be difficult, and studied until its educational possibilities are quite exhausted. Then, if a transfer cannot be obtained without changing employers, the change should be made.

### CORPORATION SCHOOLS

Instructional courses provided by some of the large corporations offer apparent advantages in making it easy to get some variety of practical experience in work without the trouble of planning one's own career. This convenient method of shirking one's responsibility in being his own guide does not on second thought recommend itself.

Every corporation-school experts' course of training is there for the purpose of helping the corporation. Certainly this object can only be accomplished by training the students or apprentices into usefulness, just as the best shop efficiency is gained by training the machine hands in the best way of doing their work. But in corporation school or shop, the aim is to teach men how to do good work for the organization. The school attitude of mind continues through all such courses. They have their place, and are of great advantage to many men whom they develop into working efficiency; but the qualities which make men conspicuously successful are not developed by years of following even the best schedule of prescribed work.

It makes after all little difference where the technical graduate does his first work, provided it is done where good work only is permitted. The really important thing is that the men in charge shall be of the highest type of successful workers, admired, respected and liked by the organization employees. This being the case, the qualities and ways by which successful work is done can be observed and imitated by the young man desiring to make himself a really valuable member of society. It is not always easy for a careless observer to perceive why a man is great among his fellows; but in ninety-nine cases out of a hundred, his greatness is not due to an accident of position. Technical education is far from complete until it includes years of study of the working methods of men who have demonstrated their ability to attain success.

# Do Cylinder Gates Increase Turbine Efficiency?

Experience, the Author Contends, Does Not Warrant Conclusions Reached in Article in Engineering Record of April 17, Page 485

By H. BIRCHARD TAYLOR
Hydraulic Engineer, I. P. Morris Company, Philadelphia

AS A RESULT of certain tests made at the Holyoke testing flume by the Holyoke Machine Company, on two 36-in. runners of similar design, one equipped with wicket gates and the other with cylinder gates, it has been called to our attention that the use of cylinder gates will result in the attainment of higher efficiencies than can be secured by means of wicket gates. The data and conclusions appeared in the Engineering Record of April 17, 1915, page 485. Aside from the question of the relative efficiencies of the two types of gate, there are also presented certain claims for the cylinder gate which refer to questions of reliability.

In view of the fact that the conclusions reached are diametrically opposed to what experience has taught, and as the particular tests from which the conclusions have been drawn appear to show exactly the opposite of what is claimed for them, we must assume that the conclusions are the result of faulty analysis of the tests in question.

### POINTS DISCUSSED

In discussing the relative merits of cylinder and wicket gates, the following are the principal points presented in the article in question:

1. "On smaller waterwheels, these [wicket gates] become very delicate and are liable to damage should they jam or become obstructed by foreign bodies. The cylinder gate in many respects is considered better, but engineers in general believe that such gates reduce the efficiency of the wheel.

2. "In cases where cylinder gates have been used, as for instance in several of the plants at Niagara Falls, where the power stations are allotted certain quantities of water and the units operate at full capacity most of the time, their selection has been governed by the fact that efficiency at small gate openings is a negligible factor.

3. "In several plants in Norway, cylinder gates have been used because the frazil and anchor ice conditions are so severe that it would be almost impossible to keep the wicket gates in operating condition during the winter months.

4. "Wicket gates are favored by many engineers because they believe that such gates are balanced, thus requiring governors of smaller capacities than other types. This, however, is not correct as, theoretically, the wicket gates are balanced in one position only."

### FACTORS OF SAFETY

The following remarks, applying in order to the above statements, may be presented:

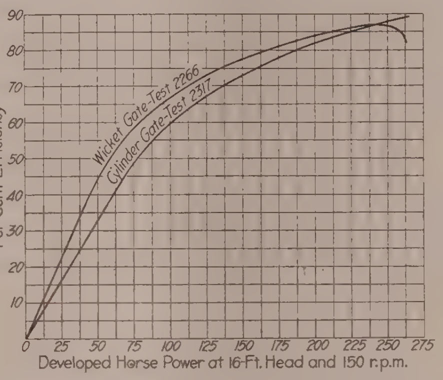
1. There is no reason why wicket gates for turbines of the smallest sizes cannot be constructed with the same factors of safety as it is desirable to secure in the larger units.

The writer is not familiar at this time with a single feature in connection with the cylinder gate wherein it may be assumed to be superior to the wicket gate. The cylinder gate, failing to survive under the severe requirements of modern practice, has become obsolete; and, to the writer's knowledge, in not a single development involving the use of turbines of modern design has the cylinder gate even been discussed.

### CYLINDER GATES OBSOLETE

2. All of the turbines at Niagara Falls which are equipped with cylinder gates are of obsolete design, a majority of them having been constructed at a time when the relative advantages of the wicket and cylinder gates were not clearly defined, and when the wicket gates were just coming into use.

The turbines which have been installed at Niagara Falls in recent years, such as the 14,000-hp units of the Ontario Power Company and the 10,000-hp units of the Hydraulic Power Company, are equipped with wicket gates. In the plant of the Toronto Power Company, Ltd., the first four 15,000-hp turbines were equipped with cylinder gates. On the completion of this installation, however, the seven additional turbines were equipped with wicket gates. The cylinder gate was selected in the first installation simply because it was the only one which had been developed and thoroughly tried out up to that time.



WICKET GATES SHOW HIGHER EFFICIENCY THAN CYLINDER GATES ON BASIS OF HORSEPOWER DEVELOPED

### ICE CONDITIONS AND BALANCE

3. The writer has had considerable experience with wicket gate turbines operating in Northern countries, where they are subject to the action of frazil and anchor ice, and has yet to hear of any difficulties in the operation of the gate mechanisms due to the presence of ice. It is quite possible that large quantities of ice may temporarily block the wicket gates, causing a considerable reduction in the output of the turbine, but the same difficulty would be encountered in the fixed vanes of the cylinder gate turbine. A wicket gate of proper design should not fail even under such severe conditions as these.

4. Wicket gates are not favored by engineers merely because they believe that such gates are balanced; for surely, enough has been said in recent years regarding the balanced position and the maximum amounts of unbalance at closed and wide open positions to make it clear that engineers are not living under a false impression regarding this question. It is now fully appreciated that the question of gate balance is of little or no moment, for the amount of power required to operate the turbine gates, even should they be out of balance for their entire range, is inappreciable when compared with the power output of the turbine.

### CORROSION OF RUNNER VANES

In comparing the relative merits of the two types of gates, there is one consideration of almost vital importance which has been omitted entirely from the article under discussion and that is the connection between the cylinder gate and the corrosion of runner vanes. In plants involving medium or high heads, experience has clearly shown that it is practically impossible to prevent the corrosion of runner vanes in turbines operated by cylinder gates.

The severe eddies created behind the cylinder gate at all openings less than wide-open position result in such complicated stream-line flow through the runner that there is not only a considerable dropping off in efficiency from this cause, but the runner vanes are subject to corrosion. Corrosion of runner vanes may be entirely eliminated in turbines regulated by wicket gates.

### EFFICIENCIES

From theoretical considerations we would expect that the part gate efficiencies of turbines equipped with cylinder gates would be adversely affected, and actual experience in the comparative tests of turbines in various installations have proved this to be a fact beyond all dispute.

The fact that the two runners tested by the Holyoke Machine Company were of the same design is not a sufficient basis for the conclusions reached in the article. The actual efficiencies secured are the efficiencies of complete experimental turbines and not of the runners alone. From the fact that the wicket-gate turbine used in the comparison showed a maximum efficiency of only 86 or 87 per cent, which is very much lower than the best results secured at Holyoke, namely, from 90 to 93 per cent, one would naturally conclude that an improved design of wicket gate if used in connection with the same runner would cause a material increase in efficiency. This statement is further supported by the fact that a runner of the same design, when tested in connection with a cylinder gate and fixed vanes, showed at full gate opening, or when the cylinder is entirely withdrawn, an efficiency of over 89 per cent, proving that the fixed vanes were of better design than the wicket gates; and there is no reason why the wicket gate, if properly designed, should not give results equal to those secured with the fixed vanes. The poor showing of the wicket gate turbine in this case, therefore, is a reflection on the efficiency of the particular gates used and not on the type.

### EFFICIENCIES AT VARIOUS POWER OUTPUTS

In comparing the performance of the two types of turbines, the efficiencies versus gate opening should not be used in the comparison, but the relative efficiencies at various power outputs should be compared. In order to compare the performance of the two units, therefore, the correct procedure lies in plotting curves between efficiency and horsepower at a constant speed.

The accompanying illustration shows two curves plotted in this manner, one applying to the cylinder-gate turbine and the other to the wicket-gate turbine, each curve being plotted from the material presented in the article. The only conclusions which can be drawn from these curves are that the wicket-gate turbine for practically all powers, from zero to very nearly full power, shows considerably higher efficiency than the cylinder-gate turbine, and that the only point where the latter shows an improvement over the former is at full power. This maximum point, however, has no commercial value, since it would be impossible to govern at full power without a margin in power above it.

### CONCLUSION

In summing up the above, the author would say that the conclusions reached in the article in question are obviously erroneous and are not justified by experience. The tests upon which the statements were based show very clearly that the wicket-gate turbine is superior to the cylinder-gate turbine, even when the comparison is made between a first-class cylinder gate and an inefficient wicket gate.

It is not altogether surprising, in view of the interpretation given to these particular tests, that the Holyoke flume has been discredited in the minds of a great many engineers.

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Mr. Taylor's discussion was referred to A. G. Hillberg, the author of the article in question. Mr. Hillberg's reply is as follows:

Mr. Taylor's first argument in favor of wicket gates refers to their factor of safety, and he states that such gates for turbines of the smallest sizes can be constructed with the same factors of safety as it is desirable to secure in the largest units. Undoubtedly they can, but as it is of importance to make such gates as thin as possible in order to avoid obstructing the flow too much, it is not always practicable to do so, especially when the units are very small. Some manufacturers, therefore, build the gates of steel plates, placing the gate shaft on one side. The arrangement is sometimes objected to, as it permits the formation of eddies.

### CYLINDER GATES NOT OBSOLETE

It is also stated, that "to the writer's knowledge, in not a single development involving the use of turbine of modern design, has the cylinder gate even been discussed." In answer to this I beg to refer to an article entitled "Niagara Falls Power Company's New Turbines," published in the Engineering Record of Oct. 18, 1913, page 443, describing the design of ten 5500-hp units. These units are all equipped with cylinder gates and their designer, C. C. Egbert, consulting engineer, Niagara Falls, N. Y., in his work at Niagara Falls has had large experience with units equipped with both cylinder and wicket gates. In that article it is stated in favor of the adoption of the cylinder gates (or ring valve, as it is called) that "while the ring valve is possibly higher in first cost than the usual form of turbine-regulating mechanism, its cost of maintenance is low, and, above all, it insures continuity of service, upon which the power company places the greatest importance." And further on, "the use of the ring valve has the disadvantage that the efficiency is lower at partial load than with other types of regulation."

These quotations are opposed to the statement made in the second point of Mr. Taylor's article. The turbines of the Niagara Falls Power Company are not of an obsolete design, as the first of them was put in operation in October, 1910. This first unit was considered as experimental; it was carefully tested for efficiency and in service, with the result that nine additional units of similar design were ordered.

### ICE CONDITIONS

The third point refers to the action of frazil and anchor ice. It is only necessary to refer to the troubles experienced at the Holtwood plant of the Pennsylvania Water & Power Company, where almost every winter previous to the last, the wheel gates have become clogged with anchor ice.

In point four it is stated that engineers are not living under the false impression that wicket gates are balanced. I beg to disagree on this point, as I have met a large number of engineers who still believe that these gates are balanced.

In closing I beg to point out that a stream of water fed to a turbine through wicket gates has different directions at different gate openings. In designing the gates and the runner, it is customary to give the direction of flow the most advantageous angle at 0.8 gate. When a cylinder gate is employed the guide vanes direct the flow of the water at a constant angle for all gate openings, which naturally tends to increase the efficiency. Because of the complicated flow lines through the runner for gates less than 0.8, the improvement in efficiency for smaller gates is not sufficient to bring the efficiency of the unit up to that obtained by wicket gates, but for larger gates the result is greater efficiency.

An important factor influencing the formation of eddies is the design of the lip of the cylinder gate. By designing the gate with an annular inclined flange at the lip, a bellmouth is formed, that decreases materially the formation of eddies.

# Letters to the Editor

*Comment on matters of interest to engineers and contractors will be welcomed*

## Pavements Dished in the Center

SIR: Considerable is heard this year—for some unknown reason—about street pavements dished in the center as being superior to pavements with gutters along the outer edges. This has arisen about once in five years for the past thirty years to my knowledge, and may have occurred at equal intervals before.

I lived in a small town once where the idea was given a trial because a prominent citizen and large taxpayer adopted it as a fad, together with another idea that on sidehill streets there should be no gutters or crown, the water flowing over the surface to the lower curb, which acted as a guide to direct the water down the block. The dished street surface was also used in a cemetery road near the same town. One winter was enough. At great cost in the spring the street was repaved with a proper crown and side gutters. In the cemetery the dished roadway compelled casket bearers and mourners to walk on the grass in wet weather.

All dust, loose papers and other débris of the street collect in the wide shallow gutter, which, in fact, is what the whole pavement becomes, and the slightest breeze starts the mass through the air, whereas if it lands in side gutters it does not move so readily. When rains or melted snow wet the street the nuisance caused by horses' hoofs or fast moving wheels is unbelievable until experienced. Storekeepers were the first to make complaint, because they could display no goods in front and in wet weather the front windows were splashed. Women and men wearing light colored suits threatened damage suits because of the splashing of water.

The writer could never see any logical argument favoring the dished pavement and his experience was interesting in the cases above mentioned, so he thinks it is well to let it be known for the benefit of those who might be otherwise led to adopt it. The street surface must be curved to the center, no matter whether this means a crown or a hollowed surface to form a wide shallow gutter. There can be no saving in expense, therefore, if curbs are used. If no curbs are used it should be an easy matter to provide narrow depressed gutters along the edge of the pavement. The difference in surface is that of a convex or of a concave curve and to insist on one rather than the other without good experience to back up the argument smacks of faddism not complimentary to the engineer.

ERNEST MCCULLOUGH.

Chicago.

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## Brick Road Construction in Florida

SIR:—The State of Florida is deeply concerned for a better condition of highway transportation. There has been provided by bond issue approximately $4,000,000 for the construction of brick roads in that State. As much more has been provided for the construction of various other sorts of roads, the particular types of which have not been selected in every case.

Considerable mileage of this contemplated improvement has already been built. A much greater portion still remains to be built. Doubtless a much greater sum than that already provided will be forthcoming in the near future. It would be a calamity, therefore, if the State should be misled in any way to its disadvantage in the expenditure of this money.

We are obliged to differ with Mr. Foote in his recent recommendation as published in the Engineering Record of April 10, page 452. The writer has been over a large mileage of the brick roads in Florida already built, and over many of the roads yet to be built. What we have to offer, if heeded, will be of value to the State.

In the city of Cleveland, Ohio, 80 per cent, at least, of the 400 miles of brick streets within the corporate limits of this city are built upon a natural-soil foundation. This soil for the most part contains a large proportion of sand and some gravel. Where the soil is such that either by natural or artificial drainage the sub-base is kept free from extreme moisture, the pavement although subject in many cases to excessive travel much beyond that passing over the Florida roads, remains in well-nigh perfect condition, and large numbers of such streets have not called for and are in no need of repair, though in service from 10 to 17 years. In Pensacola, Fla., where some of the brick pavements are laid on the sand, they are giving satisfactory service. Like examples exist in great numbers.

Brick pavements that are laid upon the natural sandy soil of Florida thus far do not show any indication whatever of any need for an artificial foundation, though the joints are only sand filled. The brick remain at grade in a remarkable way. In every instance where we found the grade out of alignment it was easily seen that it was due to the fact that black muck had been used in making the subgrade instead of sand. Let it be understood that even in sections where the black muck exists, there is plenty of clear, clean sand quite within pitching distance of the roadway. There is no need, therefore, in the preparation of the grade to substitute or employ any material whatever that would in any way be objectionable for such purpose. Muck, grass roots and black soil are not needed.

There is no reason why the grade for the brick roads of Florida may not be made almost entirely of sand, which is easily and readily drained, and, therefore, a concrete foundation would not serve any purpose whatever and would be a useless expense in that State. A roadbed of the very highest character required to meet all necessities can be made of the natural sands of Florida.

To one familiar with the soil conditions and soil behavior throughout the country, in examining the natural existing soils and sands of Florida, it at once becomes apparent that in the construction of Florida roads there is no necessity whatever for curbing. It is also a useless expense, provided, however, that the pavement is finished with due consideration of the absence of the curbing. This, of course, will necessitate the use of a cement filler in the joints of the pavement. Of course, where a cement filler is not employed a curb is necessary.

There may be and doubtless is a difference of opinion over the question of the depth of the brick in the pavement. In most of the pavements so far constructed the brick are laid flat-wise and are but 3 in. in depth. It is not doubted but that 3½ in. is better and 4 in. still better, but there is not any doubt but that the brick 3 in. deep is meeting a service with the greatest possible economy. In some instances the raised letters of the manufacturer appear on the upper side of the brick and all of these pavements laid so far are only sand filled. The brick without doubt should not be laid with the raised lettering appearing on the upper side of the pavement.

It is useless to point out by numerous examples of success favoring and supporting what we suggest as meeting most economically the requirements of Florida. The evidence is so ample and examples so numerous that it would seem that an enlightened community like Florida need not be led into following a course decidedly against her interest. They wish roads that will be entirely satisfactory in use, at the least original cost and that will endure with the least cost of maintenance.

Let it be understood once for all that an artificial foundation is not needed at all in Florida for the purpose of withstanding the weight of traffic, any more than there is necessity for placing to an indefinite depth the foundation of a building. When once you have reached a solid uniform substance upon which to place the wearing surface of the pavement, that is sufficient and it is folly to go to further expense. You do not have the extreme low temperature to contend with. This is obtainable with the natural sandy soil condition of Florida and that is all sufficient.

How then shall the brick roads of Florida be built?

*Foundation.*—The sub-base should be graded to the proper grade alignment and cross-section, after which it should be well wet and thoroughly puddled, to be followed by rolling, compressing and re-establishing the cross-section, using a self-propelling roller, the three-wheeled 10-ton type preferred. This foundation should be free from all muck and other objectionable material and be thoroughly rolled so that it will produce a uniform surface of uniform density and should be of the same contour as the finished surface of the pavement.

The crown of this road should be light and I would suggest the fall be not more than ¼-in. to the foot, or less. Even ⅛-in. fall would not be objectionable.

*Plank Edging*—We advise the elimination of the concrete or stone edging along these highways owing to the excessive cost per linear foot. The substitution of a plank 2 in. in thickness, 10 in. in depth, placed on each side of the road to hold the brick until the same are grouted. These planks should be firmly set to the proper grade of the pavement and should not be removed for at least 10 days after the brick are laid, when they can be removed and used over again on the work. The cost of these boards will be so little they might be left in place. The shoulders should at once be placed against the pavement.

*Sand Cushion*—Upon this prepared foundation shall be placed a bed of sand, which shall be 1 in. in thickness after it has been thoroughly rolled with a hand roller weighing approximately 10 lb. per linear inch. This sand cushion should be brought, by means of a template, to the proper contour of the road and to a depth below the contour corresponding with the depth of the brick used. The operation of shaping and compressing the sand cushion are considered of great importance in securing the desired evenness in the surface of the finished pavement and the contractor should equip himself with the proper implements therefor.

*Brick Pavements*—Upon this prepared sand cushion shall be placed vitrified paving brick laid according to the standard specifications of the National Paving Brick Manufacturers' Association and conforming in every way with said specifications.

After the pavement has been thoroughly grouted, care being taken to see that the joints have been made full and flush, it shall be covered with a layer of sandy soil of a depth equal to 2 in. and kept wet, if possible, for at least 24 hours. Traffic shall not be permitted on this pavement for at least 12 days or until the grout has thoroughly set.

*Remarks*—We firmly believe that a pavement constructed according to the above specifications will give a monolithic pavement, smooth, durable and one that will not rut under the traffic and will fulfil all the conditions required by the traffic of Florida.

Brick roads built in this manner are needed for the development of that State. By reason of the natural conditions found in Florida, such roads will prove economical beyond measure or estimate. Why anyone who has had experience in road building can possibly disagree with the foregoing suggestions, we are utterly unable to conceive. We hope that Florida will stick to such a program with strictest attention to these details. If so we know that a satisfied taxpaying community will ultimately remember with deepest appreciation the judgment of those who commend and stand by this method of highway improvement in that State. WILL P. BLAIR,

Secretary, National Paving Brick Manufacturers' Association.

Cleveland.

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Copy of Mr. Blair's letter was sent to Mr. Foote, author of the article criticised. He comments as follows:

Mr. Blair's statement as to the value of Florida sand as a sub-base is in accord with my personal observation. He confirms my claim that a road on such a foundation must be waterproof. He in no case defends the present Florida practice of laying brick on sand, with a sand filler, and he ignores the fact that roads so laid soon become "wavy" and irregular, due to the entrance of water through the surface.

In other words, Mr. Blair constructively builds a new type of brick road in Florida; a type never yet constructed there. According to the best data I have been able to secure, the only brick roads laid with a cement-grout filler in the State of Florida are a few streets in the city of Live Oak, the county seat of Suwanee County, and those streets are in excellent condition. A particularly noticeable feature was the absence of soft or otherwise defective brick, which suggested that the same engineering wisdom which made a waterproof surface was exercised in the inspection of material before it was placed in the pavement.

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[Contrary to Mr. Foote's statement, the Engineering Record is reliably informed, a large amount of good brick pavement is now being laid in Florida. The brick are laid on edge, with a cement-grout filler.—EDITOR.]

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EXPERIMENTS ON WATER HYACINTH have been carried on in French Indo-China for the purpose of turning to some profit the growth which encumbers the lower Mekong and other waters of Cochin China and Cambodia to such a degree that it has become a positive menace to navigation. The fibre produced by this plant, according to the "Engineer," has been used in the manufacture of rope, twine, matting, paddy sacks, boxes and chairs, cradles and other articles of furniture. It has been mixed with silk to form a somewhat stiff but durable cloth. Water hyacinth has now entered the commercial field as a rival of rattan, rather than jute. It is stated that since April, 1911, the plant has been dried, compressed into briquettes, and used as fuel at Khartum and other points on the Upper Nile. These briquettes can be put on the market at $5.75 per ton, and it is said that tests made on a steamer on the White Nile have demonstrated that their efficiency as a fuel equals that of the same amount of the best coal.

# HINTS FOR THE CONTRACTOR

## Details Which Save Time and Labor on Construction Work

*Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents*

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

### A Mixer Layout That Saved Money

IN ORDER to save the cost of high towers in pouring concrete for their new plant at Canton, near Baltimore, Md., the Standard Oil Company erected a Chain Belt mixer on an elevated platform with a boom construction and spouting arrangements, as shown in the accompanying photograph. The mixer was used for putting in seven concrete foundations for still settings as well as a number of columns. Pouring was facilitated by working the chute and boom at an angle. The mixer tower was moved on skids over an area covering about 1000 ft. Those in charge state that if the plant were to be erected again the tower would be put on wheels and tracks, which would have saved them considerable time and expense in moving and would have eliminated the necessity of blocking up each time they moved. A 30-ft. extension loader was used with the mixer.

MIXER AT TOP OF MOVABLE TOWER

### Troubles with Hydraulic Jacks

HYDRAULIC jacks sometimes fail to develop full capacity, or settle slowly when left standing under a load, without apparent reason. Such failures, says the engineering department of the Travelers' Insurance Company, are commonly due to defective packing. These defects are first evidenced by the failure of the jack to raise or hold the load, and when this is noted the jack should be examined to find out where the packing failed to hold. The leakage at the defective point is usually readily detected.

A well known manufacturer of hydraulic jacks makes these recommendations with regard to the valves and their seats: If the packing is in good order and the ram does not rise in pumping, the suction valves are not working properly. If the lever rises when the hand is removed the pressure valve is not working properly. If the valves or their seats become worn or scratched, grind them to a fit with oil and a little flour of emery. Be careful not to grind them too much, and be sure to wash the valves and their seats perfectly free from emery before putting the jack into service again. If the valves are deeply scored or have become too much worn, replace them with new ones, and grind new ones lightly to their seats, as described. If the seats are deeply cut they should be reset, and if very deeply cut they should be both reamed and reset.

### Steam Shovel Digs 48-Inch Pipe Trench in Busy Street

By FREDERICK H. POND
Assistant Engineer, Board of Water Supply,
New York City

TRENCH excavation by a traction steam shovel for a 48-in. cast-iron pipe on a busy street was the expedient resorted to in bringing to a speedy completion that part of the Catskill aqueduct leading from the Narrows siphon to the Silver Lake tunnel and reservoir in Tompkinsville, Staten Island. The 48-in. pipe was laid along Richmond Turnpike, one of the busiest thoroughfares of the island, and was placed in the street 4 to 6 ft. from the curb and near the trolley tracks.

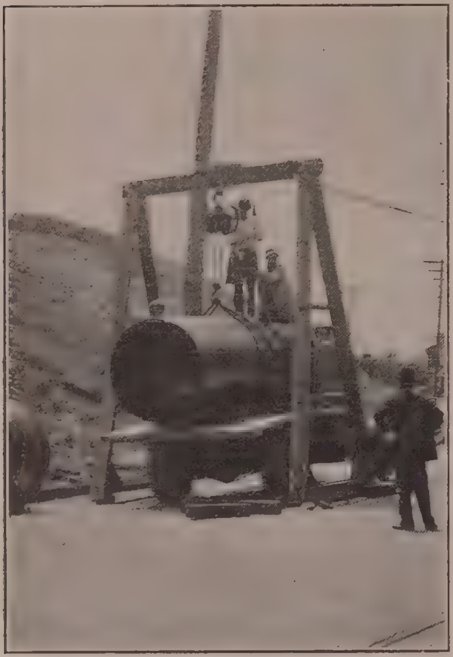
Difficulties in the way of steam shovel operation were poles and wires of the Public Service companies, trees near the curb line, various sub-structures, and a 4-in. water line for house and fire service which extended 2200 ft. along the trench line. It was necessary to relay this pipe temporarily along the bank and maintain it in service until the 48-in. pipe was laid, after which the 4-in. line was permanently replaced in the trench. Trees that were in the way were guyed back, and a number of poles had to be moved. Temporary crossovers were used on each side of the steam shovel, so that street cars did not pass on the track next to it.

The 32-ton steam shovel, which had a ⅞-yd. bucket, was supported over the trench by a platform composed of 8 x 8-in. timbers 16 ft. long, extending over the sidewalk, as shown in the photographs. A force of about five men shifted the timbers ahead as the shovel progressed. The presence in the street of the 48-in. pipe ready for laying, as well as the necessity of keeping the street open to traffic made the disposition of material a problem. Excavated material was piled on the banks or loaded directly into dump wagons, which hauled it to nearby storage piles where it was available for refilling.

The average cover over the 48-in. pipe was 4 ft., calling for a trench nearly 9 ft. deep. The shovel opened up a trench about 5 ft. wide approximately to the required depth. Final trimming and grading were done by hand. A large portion of the trench was excavated through granite block pavement with cement or asphalt filled joints, on a concrete foundation. The blocks, removed by hand, were saved for future use and the foundation was broken up by the shovel, after being perforated by three rows of 1-in. holes about 8 in. apart along

THIS SHOVEL AVERAGED 90 FEET A DAY IN ROCK CUT 8 FEET DEEP the line of the trench. These holes, one row in the center and one on each side of the trench, were drilled to prevent excessive breakage.

About three-fourths of the 4093 lin. ft. of the contract was excavated by the steam shovel. The balance, where traffic conditions, treacherous soil, or hard rock rendered this method impracticable, was excavated by hand. The material encountered was clay with more or less sand, gravel and loam, and disintegrated serpentine. The latter under ordinary conditions would require picking or wedging, but it was removed effectively by the steam shovel except for a short stretch where light blasting was required.



FRAME LIFTS 4-FOOT CAST-IRON PIPE FROM TRUCK TO STREET

Work under the conditions described was naturally slow. A fair average progress during an 8-hour day was 90 lin. ft. in disintegrated serpentine, and 105 lin. ft. where only earth was encountered, representing 142 cu. yd. and 165 cu. yd. per day respectively. The average cost, as estimated by the engineer, was 44 cents per cubic yard. This included fuel, oil, repairs, storage, operators, depreciation, interest, overhead charges, etc. Under favorable circumstances the shovel made as much as 150 ft. per day in both classes of material.

The 48-in. pipe sections, weighing about 5 tons each, were brought to the work on motor trucks. A portable frame with a 5-ton chain block raised the pipe from the truck and deposited it upon the street after the truck had been driven from beneath it. One truck averaged 14 pipes per day, about 105 ton-miles, at a total haulage cost, as estimated by the engineer, of 65 cents per ton, or 43 cents per ton-mile. This includes all charges incidental to trucking. Unloading and handling at the destination amounted to 10 cents per ton additional.

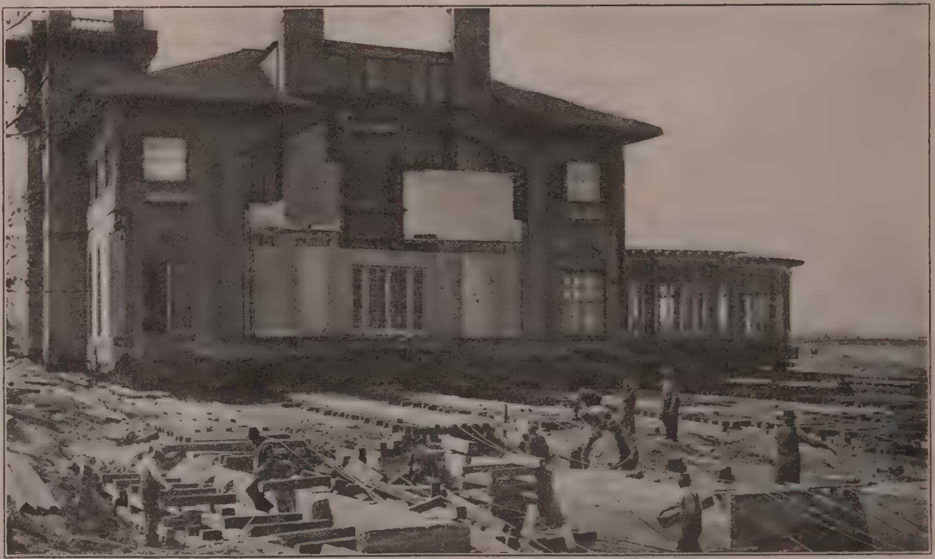
This work was recently completed by the Beaver Engineering & Contracting Company, Walter J. Drummond, president, under the direction of the Board of Water Supply of New York City, of which J. Waldo Smith is chief engineer, W. E. Spear, department engineer, and J. P. Hogan, division engineer.

## Fifteen Hundred-Ton Country Club Moved 1200 Feet

NEATLY sliced away from its foundations, mounted upon rollers, and propelled by six horses whose tractive power was multiplied by the use of a series of forty pulleys, the unwieldy 1500-ton main building of the South Shore Country Club, Chicago, was recently moved 1200 ft. to a new location in order to make way for the construction of a new clubhouse.

The utmost care had to be exercised owing to the nature of the soil over which the movement was made and the fragile character of the heavy structure. A runway had to be designed and built over a low sandy beach, which might at any time be submerged as the result of a northeast gale. Sand was scraped out from ground over which the movement took place and banked near the water line of Lake Michigan, less than 100 ft. away. A temporary breakwater, 700 ft. long, was constructed of piles and sheeting a short distance off shore. Any undue settlement, which would result in structural cracks to the building, had to be carefully guarded against.

The exterior walls of the clubhouse are of 2 x 6-in. studs, plastered on the outside with metal lath and cement plaster. In order to tie these fragile exterior walls of the building properly together, 2½ ft. of the foundation wall covering the complete periphery of the building was retained in moving. The building was first fenced off to keep spectators from walking into danger. Then several of the smaller wings were lopped off and rolled down to their new location. With pneumatic apparatus the concrete foundations were cut through and the building jacked up by 575 jackscrews with a total lifting capacity of 57,500 tons. The building minus its wings was 320 ft. long and 139 ft. wide. After being jacked up 12 x 12-in. timbers with their ends lapping were placed under the entire width of the building so that they formed a complete tie. Under these came ten runs of 18 x 18-in. timbers to which the cables and pulleys were attached. Then came a saddle of timber 4 x 12 in. and 4 ft. long, which rested on the rollers. The rollers, which were 7.5 in. in diameter and 4 ft. 8 in. long, were placed in a series of four. The track over which the building was rolled consisted of closely spaced 4 x 5-in. hickory timbers, 12 ft. long. Where two towers of the building extended out on the side structural steel beams were used as cantilever supports. Heavy 1-in. cable was tied around the 18 x 18-in. timbers and run to the pulleys. For pulling ⅝-in. cable was used. New foundations were built upon the new site for the old structure and it was lowered and put on its new resting place without any cracks to the floors, walls or partitions.



PART OF OLD CONCRETE FOOTING STIFFENS FRAGILE BUILDING FOR LONG MOVE

About four weeks were spent in getting the building ready for moving. Twelve days were required for the total movement, the average run per day being 100 ft. The building was occupied by club members during the operation and the transition was made so easily and silently that no noise louder than the shout of the foreman could be heard inside of the handsomely appointed structure. The L. P. Friestedt Company, of Chicago, were the contractors.

## Build First Floor on Form Work Before Pouring Basement Walls

By GEORGE E. HINCHLIFF

The George Hinchliff Company, Contractors, Chicago

IN ERECTING a store and flat building recently in Chicago the first floor framing was built on the form work before the concrete basement walls and piers were poured. The floor joists rested on the concrete basement walls and on beams supported on interior piers of concrete. Above the first floor the outside walls of the building were of brick. The spread footings for these piers and walls were first poured and the form work erected on them. By erecting the first floor framing on this form work the contractor avoided the necessity of building runways to distribute the concrete. These runways would have to have been built inside the cellar excavation as the contractor could not make use of any of the adjoining property. The trouble of chopping notches out of the ends of the joists bearing on the walls, or of chipping under them, to get the floor level, also was avoided. The entire framing was leveled up before the concrete was poured, and a good bearing secured under the ends of the joists while they were held at correct grade.

# NEWS OF THE WEEK

**Passing Events in the Civil Engineering and Contracting Fields**

## High-School Graduates Command Higher Salaries than College Men

Much discussion is taking place among Illinois engineers over an announcement of the Illinois Civil Service Commission of examinations for positions with the Illinois Public Utility Commission. The following examinations, with salaries attached to the positions, are announced: Electrical engineer, $200 to $300 a month; assistant chief utilities engineer, $300 to $375 a month; service engineer, $200 to $300 a month; mechanical engineer, $160 to $250 a month—for all of which positions an engineering-college degree is required. However, for the following positions, with duties equally important, only a high-school education is required: Telephone engineer, $200 to $300 a month; gas engineer, $250 to $333.33 a month; railroad engineer, $250 to $333.33. It will be noted, too, that the high-school men are given higher salaries than some of the positions requiring college men.

Illinois engineers are asking why the bars were let down for three of the positions, in no way inferior in responsibility to the others, and why for these three, excepting the assistant chief utilities engineer, evidently a ranking officer, a uniformly higher salary is allowed.

## New York State Storage Reservoir Bill Signed

Governor Whitman of New York signed the Machold bill, which provides for river regulation by storage-reservoirs, on May 20. The measure permits the establishment of river-regulating districts under the control of a board composed of the conservation commissioner, the attorney-general and the State engineer.

## Claim Rising of Lake Was Due to Seepage from Cedar River Dam

From all indications the City of Seattle will have about thirty-two suits for damages on its hands due to the rise of Rattlesnake Lake, which, it is declared, was caused by the seepage from the north bank of the Cedar River reservoir at the new masonry dam at Cedar Falls, the source of Seattle's municipal water, light and power supply. As a result of the rising of the lake fifty-two residences and business structures in Cedar Falls are tenantless, thirty-two property owners have been damaged and more than fifty persons driven from their homes. The above figures were given out by city officials following an investigation of the situation at Cedar Falls. The exact amount of the damage has not been determined, but in round numbers it is believed the flood has done not less than $40,000 worth of damage to property alone. When the suits for damages are filed, it is intimated, in several cases at least, damages for loss of rentals and inconvenience will be asked.

## American Machines Dig Trenches in Canadian Army Camps

That American-made machinery is playing its part in the present war is strikingly shown in the accompanying photographs of ditching and trenching machines at work digging trenches for drainage, sewers and movable targets in the Canadian army camps. At Camp Sewall two Austin machines dug 7 miles of trench 5½ ft. deep, with a 2-ft. bottom in ten days. In one of the camps one mile of movable practice targets, closely spaced, have been erected in the trenches. General Sam Hughes, commander-in-chief of the Canadian Militia, has charge of the camps, which have already furnished the allied armies with 100,000 men, and are training 150,000 more.

TOUGH MARL BROKEN UP BY BLASTING AT CANADIAN ARMY CAMPS

## Board Named to Control Engineering Foundation

Members of National Engineering Societies and Others Will Administer Fund of $200,000, Inaugurated by Ambrose Swasey

Rules of administration were adopted and officers elected at the first meeting of the Engineering Foundation, held in New York May 25. This trust, the first of its kind devoted to engineering interests, was inaugurated early this year by Ambrose Swasey's gift of $200,000, to be applied, as announced in the Engineering Record of Jan. 30, "to the advancement of the engineering arts and science, to the greatest good of the profession and to the benefit of mankind. The foundation has been organized by the United Engineering Society, representing jointly the National organizations of electrical, mining and mechanical engineers, with the co-operation of the American Society of Civil Engineers, combining about 30,000 members.

The newly elected officers are: Chairman, Gano Dunn; vice-chairman, Edward D. Adams; secretary, F. R. Hutton; treasurer, Joseph Struthers.

The board administering the trust consists of Edward D. Adams, banker; Gano Dunn, president, the J. G. White Engineering Corporation; Howard Elliott, president, New York, New Haven & Hartford Railroad; Alexander C. Humphreys, president, Stevens Institute of Technology; Charles Warren Hunt, secretary, American Society of Civil Engineers; A. R. Ledoux, past-president, American Institute of Mining Engineers; M. I. Pupin, professor, electro-mechanics, Columbia University; Charles E. Scribner, chief engineer, Western Electric Company; J. Waldo Smith, chief engineer, Board of Water Supply, City of New York; Jesse M. Smith, past-president, American Society of Mechanical Engineers, and Benjamin B. Thayer, president, Anaconda Copper Company.

Applications for the use of funds were received in large numbers and a committee was appointed to consider them, consisting of A. R. Ledoux, chairman; J. Waldo Smith, M. I. Pupin and Alexander C. Humphreys. Most of the applications were in such form that they could not be considered. It is realized by the Engineering Foundation that it is of the highest importance that research shall not be duplicated and consequently that a thorough investigation of the existing state of knowledge on the subject is an important part of every project of research, in order to prevent duplication and the waste of effort. To this end the following general rule relating to researches has been adopted:

"Before any request for research work shall

ARMY CAMP MACHINES HIKE TO WORK UNDER THEIR OWN POWER

DITCHER AT WORK IN THE TRENCHES AT CAMP VALCARTIER be considered a statement shall be placed before the board of the object sought to be accomplished by such research, together with a complete résumé of the knowledge on the subject to date, in order that the board may arrive at an intelligent decision as to the probable value of such research."

## Motion Picture Industry Invades Engineering Field

"Reel" records of engineering accomplishments and demonstrations of various brands of material and types of equipment are the latest educational means employed by the engineer, municipality and manufacturer, not only for the engineers themselves but for the great lay public. The Western Society of Engineers has a motion picture committee whose duty it is to procure and censor industrial and other types of pictures. The Health Department of Chicago has had permanent records made of its temporary garbage disposal plant for the sake of record, although these films have been shown privately to a few engineers. W. S. Rothacker, general manager of the Industrial Motion Picture Company, states that he has just completed a series of reels for the U. S. Gypsum Company demonstrating the uses and manufacture of Sackett board and Pyrobar; for the Du Pont Powder Company showing various uses of its products in blasting (the films to be used in South America). The General Fireproofing Company, Universal Portland Cement Company, the Underwriters Laboratory, the National Tube Company, the Barber Asphalt Paving Company are also using "movies" extensively.

## Absurdity of Illinois Law Requiring Licensing of Architects

As an instance of the absurdities resulting from the Illinois law for licensing architects, the legislative committee of the Western Society of Engineers, which is pushing a structural-engineers' licensing bill, cites the following in its most recent appeal to the Legislature:

"The foundation plans for the freight house of the new Pennsylvania Railroad terminal in Chicago were prepared and executed by the engineering department of the Pennsylvania company, and last week a building permit was refused because the plans did not bear the stamp of a licensed architect. (It is not likely that there are a dozen licensed architects in Chicago, barring those engineers who hold architects' licenses, competent to make plans of this kind.) Finally an architect's license was granted without examination to Thomas Rodd, consulting engineer of the Pennsylvania company, and the permit was issued."

## National Societies Unite in Classification of Technical Literature

Delegates from about twenty National technical and scientific societies met in the United Engineering Societies' Building, New York, on May 21, 1915, to perfect a permanent organization, the purpose being to prepare a classification of the literature of applied science which might be generally accepted and adopted by these and other organizations.

There was a generally expressed opinion that such a classification, if properly prepared, might well serve as a basis for the filing of clippings, for cards in a card index, and for printed indexes; and that the publishers of technical periodicals might be induced to print against each important article the symbol of the appropriate class in this system, so that by clipping these articles a file might be easily made which would combine in one system these clippings, together with trade catalogs, maps, drawings, blue prints, photographs, pamphlets and letters classified by the same system.

By request, W. P. Cutter, librarian of the Engineering Societies' library, and a delegate from the American Institute of Mining Engineers, read a paper on "The Classification of Applied Science," in which, after describing the existing classifications, one of them his own, stated that, in his opinion, no one of these, although having excellent features, was complete and satisfactory enough to be worthy of general adoption. He outlined a plan whereby a central office could collate all the existing classifications, and, with the help of specialists in the various National societies interested, might compile a general system, which, although perhaps not absolutely perfect, might meet with general acceptance and adoption.

Permanent organization was effected by the election of the following officers: Chairman, Fred R. Low; secretary, W. P. Cutter; executive committee, the above, with Edgar Marburg, H. W. Peck and Samuel Sheldon.

It was agreed that a special invitation to participate by the appointment of a delegate be sent to other National societies which might be interested in the general plan.

As indicative of the broad scope of the proposed work there were present representatives from not only the National engineering societies, but from the Bureau of Standards, the Franklin Institute, illuminating, railway, fire-protection and other associations.

The executive committee was charged with the task of enlarging the membership of the committee to include delegates from all similar National organizations, and the preparation of a plan for further action.

The delegates present expressed most hearty and enthusiastic personal interest in any system which might be worthy of general adoption; they could, of course, not promise at this early date, anything more than moral support to the idea, reserving for themselves and for their societies the right to examine thoroughly any system that might be evolved before recommending its adoption.

The name adopted for this organization is the "Joint Committee on Classification of Technical Literature" and the temporary address of the secretary, W. P. Cutter, is 29 West Thirty-ninth Street, New York.

## City of Detroit to Entertain Conference on City Planning

The City of Detroit will be host to the Seventh National Conference on City Planning which will be held in that city, June 7-9, with headquarters at Hotel Statler. Included among the speakers will be: Nelson P. Lewis, chief engineer, Board of Estimate, New York City, and E. P. Goodrich, consulting engineer, Borough of Manhattan, New York City.

## Concrete Pavement Allows Heavy Trucks to Climb Steep Grades

Heavy trucks and wagons that heretofore have found the steep grades of Eighteenth and Nineteenth Streets, south of Grand Avenue, Milwaukee, impassable barriers, no longer fear their forbidding slopes. The reason for this lies in the fact that the 15.3 per cent grade on Nineteenth Street and the 13.5 per cent grade on Eighteenth Street have been paved with concrete. Specifications for these streets were similar to those used at Sioux City, Ia.: Width, 30 ft.; thickness, 6 to 8 in.; crown, 4 in.; mix, 1:2½:4; aggregate, clean and well graded sand and crushed granite ranging in size from 2 in. down; mortar surface; 1:1 of cement and granite dust broomed onto the surface; transverse joints of tar and felt 25 ft. apart. The cost was 90 cents per sq. yd.

MOTOR TRUCK CLIMBS 15.3 PER CENT GRADE PAVED WITH CONCRETE

## Government Starts Country-Wide Inquiry for Road Data

The Department of Agriculture is gathering information which, when complete, should not only give the total mileage of public roads in the United States and their cost, but should serve as a basis for estimating the relative value of the different kinds of highways. Some 15,000 sets of inquiry blanks have already been distributed through the State highway commissions, and some of these are now beginning to come back to the department. Each set consists of four cards.

Of these the first asks for information on the mileage of different classes of roads in the county to which it is sent. The mileage does not include, of course, streets in cities and towns. The roads are divided into 10 classes, as follows: Brick paved, concrete, macadam with the addition of some substance, such as asphalt, oil, or tar; plain macadam, gravel, shell, other hard-surfaced roads, sand and clay mixture properly graded and drained, ordinary earth roads properly constructed, and, finally, unimproved roads.

The second card asks for information in regard to the tax rate for the roads and the amount of work and money expended on them.

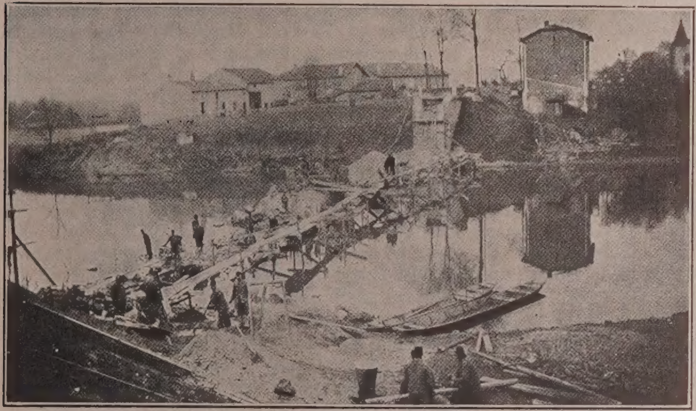
The third blank is concerned with the names of local road officials, and the fourth with facts in regard to the bond issues and the indebtedness of the counties for their road systems.

When the information in regard to the existing roads which the department is now seeking is complete, it is the intention to continue the inquiry year after year in order to ascertain the durability and economy of the various kinds of highways. The data thus collected should be useful to road engineers all over the country, and it is hoped that county agents and others interested in improvement of agriculture will do their best to facilitate the collection of the desired information.

## Mr. Birkinbine's Successor

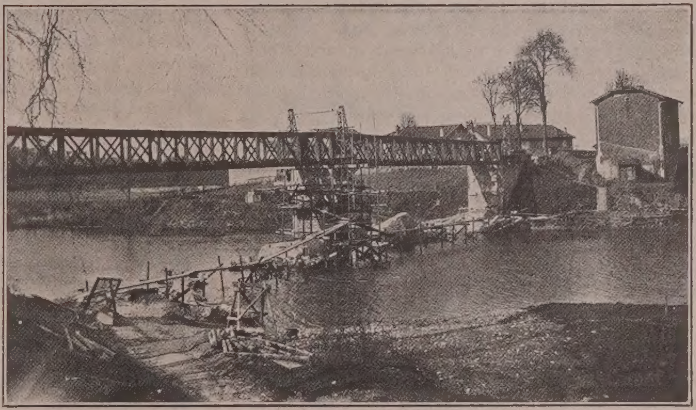
The loss to the State in the death of John Birkinbine, the engineer chief of the State Water Supply Commission, is realized by the engineers of the commonwealth, if not by the people generally. He gave to the State his best efforts and in the organization of the commission brought the experience of a long and useful life devoted to the solution of difficult engineering problems, especially in their relation to the health of the people.

Now that he has finished his work it will doubtless be the aim of Governor Brumbaugh, who has a high appreciation of the conservation needs of the State, to select as the engineer of the commission one who will compare with Mr. Birkinbine in all the qualities which made him an ideal chairman of the commission. The filling of this office should not be so much a matter of political consideration as of personal fitness for a most important place in the public service.—*Harrisburg (Pa.) Telegraph.*



BRIDGE DESTROYED AT DIEU LOUARD, FRANCE

*Courtesy New York Times*



REBUILT IN A FEW DAYS BY NAVAL ENGINEER CORPS

## Illinois Bill Proposes Civil Service for Sanitary District

Civil service for the Sanitary District of Chicago is the object of a bill passed by one branch of the Illinois Legislature and well on its way in the other. It contains a blanket clause to protect present employees and creates a civil service commission composed of a superintendent of employment, named for six years, and two trustees. As all members of the commission are named by the majority trustees there is complaint that the bill is vicious in that there is no minority check on the commission's actions.

## Municipal Engineers of New York Issue Monthly Journal

The Municipal Engineers of the City of New York have issued the first number of a "Journal" which is to be published monthly in the interests of the society. It will be edited by Percy C. Barney, who has had a long experience in the handling of the Board of Water Supply's printed matter, including annual and special reports, contracts, specifications, etc. The journal will contain advance copies of the papers to be presented at the society's meetings, reports of past meetings, names of new members, personal notes, accounts of inspection trips and a section headed "Our Associate Editors," in which communications from members will be printed.

The May issue contains several reports on the subject of standardizing salaries and grades of engineers in the municipal service, and papers by Henry Welles Durham on "Problems of Street Paving in Large Cities" and by George B. Ford on "The City Controlling the Development of Private Property."

Several pages also are devoted to suggestions submitted to the New York State Constitutional Convention by a committee of engineers representing both national and local engineering societies.

## Brooklyn Marginal Railroad Bill Becomes Law

The Brooklyn marginal railroad bill was signed May 24 by Governor Whitman of New York, and it now becomes possible, after a long delay, for New York City to proceed with its comprehensive plan for developing the waterfront of Brooklyn and Queens from Long Island City to Sixty-fifth Street, Brooklyn. The bill permits existing railroads to hold securities in the terminal company proposed, such authority being essential to the carrying out of the project. The bill was bitterly opposed by those who thought it was giving control of the waterfront to the railroads, and last year a similar bill was vetoed by the Governor.

## U. S. Office of Public Roads to Have Wider Scope of Duty

In the reorganization of the work of the U. S. Department of Agriculture the irrigation and drainage investigations formerly carried on by the Office of Experiment Stations and the farm architectural work conducted by the Office of Farm Management have been transferred to the Office of Public Roads, which will hereafter be known as the Office of Public Roads and Rural Engineering.

## Army Engineers Consider Canal from Lake Erie to Lake Michigan

Investigation of a plan for a canal from Lake Michigan to Lake Erie is under way. A committee of army officials, consisting of Col. John Mills, Lieut.-Col. W. V. Judson, Major P. S. Pond and Capt. L. H. Watkins, has been studying the matter and conferring with various interested parties. The main route of the proposed canal is from Toledo, Ohio, to Fort Wayne, Ind., but from the latter point west several routes have been considered. The estimated cost is from $135,000,000 to $147,000,000, and arguments have been presented that the cost should be divided equally among the Federal Government and the States directly benefited.

## California Railroad Commission Hears Water Supply Experts

The Railroad Commission of California is hearing a petition of the People's Water Company of Oakland for permission to reorganize. J. B. Lippincott, of Los Angeles, placed the value of water rights of the company at $100,000 per million gallons capacity per day. Under a long cross examination it was brought out that the present capacity of the People's Water Company is 16,000,000 gal. per day, and on that basis it is valued at $1,600,000. The reserve supply, placed at 18,000,000 gal., was given a value of $15,000 per million gallons. The total value placed on the water rights by Mr. Lippincott, including the reserve supply, was $2,500,000.

## New York Public Service Commission Exonerated

Governor Whitman dismissed May 26 the charges before him against four of the public service commissioners for the first district of New York State—Edward E. McCall, chairman; J. Sargeant Cram, George V. S. Williams and Robert C. Wood. In giving his decision, the Governor stated that the actual charges of neglect of duty brought against these men were trivial, and that if their removal, caused by him, were subject to review by any Appelate body, such a body would certainly reinstate them. The Governor further states in his memorandum disposing of the charges that though he has power to remove the commissioners, he does not feel justified in disregarding simple rules of evidence in order to do so.

The utilities commission of the Constitutional Convention now in Albany has received recommendations looking toward removing the two New York commissioners from even the suspicion of political control, made by the chairmen of both commissions and by other prominent men. One suggestion is to require a two-thirds vote of the State Senate for the removal of any commissioner. Edward E. McCall thinks that not only would it be ruinous to the commissions and their work if they became political, but that any party with the hardihood to make them so would soon be wrecked by the consequences of the step.

## Committee Seeks Advice on Improving Engineering Education

To obtain a representative expression of opinion from members of the profession in regard to engineering education the joint committee on engineering education of the National engineering societies and the Carnegie Foundation for the Advancement of Teaching, acting in co-operation, are circulating the following questions:

1. What are the particular points at which the work of the engineering schools is effective and successful?

2. What are the particular points at which the work of engineering schools is least effective and successful?

3. What specific experiences illustrate the conclusions expressed in your answers to questions 1 and 2?

4. What are the most important factors in determining probable success or failure in engineering?

5. When examining a candidate for a prospective job, what sort of information is best calculated to assist in judging his fitness and probable success? Give samples.

6. What sort of work, what specific jobs, what kind of experiences are most effective in testing a man for fitness and probable success in engineering? Give samples.

7. Have you ever found a knowledge of either French, German or Spanish essential to your professional career?

8. Should a reading knowledge of one of the modern languages be required of every engineer? Why?

9. Make specific suggestions for the improvement and strengthening of engineering schools.

## News of Engineering Societies

**The Connecticut Society of Civil Engineers** will hold a smoker at the new City Hall, New London, this evening.

**The Massachusetts Highway Association**, the Association of Connecticut Highway Officials and the Mayors' Club of Massachusetts, will hold a meeting at Springfield, Mass., June 2 and 3. There will be a banquet at the Hotel Kimball on the evening of June 2 and the next day will be devoted to an inspection of street construction in the Springfield district. C. A. L. Wright of the Springfield engineering department is chairman of the general committee and has prepared a souvenir booklet for the occasion.

**The Engineers' Club of Baltimore** will hold its annual meeting at 5 W. Eager St., that city, June 3. The following candidates will be voted on for office: For president, J. Fletcher Apsey, Oscar F. Lackey and W. W. Pagon; for chairman of the house committee, R. M. Cooksey, John N. Mackall and W. W. Varney, and for members of board of directors (three to be elected), R. B. Clapp, R. Keith Compton, O. C. Cromwell, W. W. Crosby, J. C. Little, J. H. Sutton, C. J. Tilden, H. A. Warren, Albert H. Wehr, Ezra B. Whitman and H. D. Williar, Jr.

## Personal Notes

S. A. Preston has been elected city engineer of Fremont, Neb.

V. M. Ehlers has been appointed State sanitary engineer of Texas.

C. C. Bonebrake has been reappointed city engineer of Santa Ana, Cal.

S. B. Weir has been appointed county engineer of Taylor County, Iowa.

W. W. Johnston has been appointed highway engineer of Etowah County, Ala.

W. F. Downing has been appointed inspector of roads of Jessamine County, Ky.

Ross A. Frederick has been appointed city engineer of Sault Ste. Marie, Mich.

Frederick A. Caldwell has resigned as assistant city engineer of Providence, R. I.

J. W. Mavity, of Lyndon, Kan., has been appointed city engineer of Wellington, Kan.

E. F. Peterson has been appointed city engineer of Muskogee, Okla., succeeding Harry White.

C. M. King, consulting engineer, of Sandusky, Ohio, has been elected county engineer of Erie County.

George B. Holbrook has been elected president of the Connecticut River Railroad, succeeding John H. Alvin.

C. L. James, formerly city engineer of Mattoon, Ill., has been appointed superintendent of the municipal waterworks.

John W. Budd, formerly assistant engineer of Des Moines, Iowa, has been appointed county engineer of Polk County, Iowa.

R. J. Windrow has been reappointed county engineer of McLennan County, Texas. He was originally appointed to that office in 1913.

H. H. Simmons, formerly assistant engineering editor of the Railway Age Gazette, has been appointed editor of the Signal Engineer.

Henry A. Varney has been appointed city engineer of Brookline, Mass., succeeding Alexis H. French, whose death was noted in the journal, May 8.

John A. Goetz has been appointed city engineer of Mattoon, Ill., succeeding C. L. James, whose appointment to another position is noted elsewhere in these columns.

John C. Tracy, formerly assistant professor of structural engineering at Sheffield Scientific School, Yale University, has been elected professor of structural engineering.

Charles A. Miller, until recently connected with the Portland-Eugene & Eastern Railway, has been appointed city engineer of Oregon City, succeeding C. S. Noble, resigned.

First Lieut. Joseph C. Mehaffey, Corps of Engineers, U. S. A., has been assigned for duty with the Board of Road Commissioners of Alaska with headquarters at Valdez.

Walter S. Lacher, formerly office engineer in the engineering department of the Chicago, Milwaukee & St. Paul Railway, has joined the editorial staff of the Railway Age Gazette.

John P. Garner, formerly manager of the Chicago Telephone Company, has been made public service commissioner of Chicago at a salary of $6,000 a year. He succeeds Montague Ferry.

J. E. Mason, assistant secretary of the Western Society of Engineers, Chicago, has resigned from that position to join the staff of the McGraw Publishing Company in its Chicago office.

L. A. McElheney, formerly connected with the construction department of the Illinois Central Railroad in Chicago, has been appointed to have charge of the grade elimination work of that company at Mattoon, Ill.

R. W. Richardson, formerly assistant superintendent of the Intercolonial & Prince Edward Island Railroad, has been appointed superintendent of the Fort William to Winnipeg section of the National Transcontinental Railway.

Charles Saville, of the firm of Bartlett & Ranney, Inc., consulting engineers, of San Antonio and Dallas, Texas, has been appointed director of sanitation under the recently reorganized Department of Health of the City of Dallas.

Rossback & McKee, civil engineers of Fort Wayne, Ind., have been retained as engineers in connection with the construction of a municipal waterworks plant at South Lyons, Mich., and, in the same capacity, on street improvement work at Chelsea, Mich.

F. P. Brady, for the past nine years superintendent of the Intercolonial & Prince Edward Railroad, has been appointed general superintendent of the National Transcontinental Railway between Quebec and Winnipeg. His headquarters will be at Cochrane, Ont.

H. C. Wells, of the U. S. Office of Public Roads and Rural Engineering, has arrived at Fort Wayne, Ind., where he will be stationed for the next few months assisting the road commissioners and superintendent of Allen County in building the roads to be constructed there this season.

Dr. George A. Soper, former president of the Metropolitan Sewerage Commission of New York and chairman of the board of experts commissioned by the Chicago Real Estate Board to study Chicago's sanitary requirements, spoke May 26 before the ways and means committee of the Chicago Association of Commerce. His subject was "The Future Sanitary Needs of Chicago."

Benjamin F. Cresson, chief engineer of the New Jersey Harbor Commission, was selected as temporary chief engineer of the new Department of Conservation and Development of the State of New Jersey, which goes into office July 1, at a meeting of the members held in Trenton, May 1. John C. Payne was chosen as assistant engineer.

George Cromwell has been appointed city engineer of San Diego, Cal., succeeding W. M. Rumsey. Mr. Cromwell was graduated from Stanford University in 1904 and has been engaged in engineering work since that time, principally in connection with pipe line construction, mineral surveying, highways and water-power developments.

J. K. McNeillie, lately superintendent of District 3 of the Canadian Pacific Railway, with offices at Montreal, has been appointed general superintendent of the Intercolonial & Prince Edward Island Railroad, succeeding F. P. Brady, whose appointment to another post is noted elsewhere in these columns. His headquarters will be at Moncton, N. B.

Col. James C. Sanford, Corps of Engineers, U. S. A., who has been in charge of surveys of northern and northwestern lakes with headquarters at Detroit, Mich., has been ordered to take charge of the engineering operations at New Orleans, succeeding Col. John Biddle, Corps of Engineers, U. S. A., who has been detailed as war observer in Austria-Hungary. The order will be effective July 1.

E. N. Layfield, consulting railroad engineer, has been elected assistant secretary of the Western Society of Engineers and editor of the journal. Six years ago Mr. Layfield was chief engineer of the Chicago Terminal Transfer Railway Company during a period of extensive track elevation work. More recently he was consulting engineer for the city of Houston, Texas, on track elevation work.

Samuel D. Clinton, formerly assistant engineer of the State Highway Commission of Idaho, has been appointed field engineer of the Interstate Commerce Commission, Division of Valuation, Fifth Division, with headquarters at San Francisco. He was graduated from the University of Nebraska in 1902 and engaged in railroad work continuously until 1907, when he was engaged by the International Contracts Company, of Seattle, Wash., to look after steam shovel work, laying of water mains, and the construction of docks, dams and bridges. In the latter part of that year he took up land drainage and irrigation work, which he followed for several years.

John Wilson, whose resignation as city engineer of Duluth was noted in these columns May 8, has opened offices in the First National Bank Building, Duluth, where he will engage in the general practice of civil and sanitary engineering, making a specialty of municipal problems. Mr. Wilson was graduated from the University of Wisconsin in 1903, and engaged in railway location, construction and maintenance for the next 4 years. From 1903 to 1911 he was city engineer of Mankato, Minn., during which period he took special work in sewage disposal at the University of Michigan and from 1911 to 1912 was special assistant engineer on sewerage designs for Duluth. He was appointed city engineer of that city in 1912. For the past eight years he has been engaged in private practice in addition to his public duties and has designed a number of sewage disposal plants and waterworks systems.

J. X. Cohen, assistant engineer on the staff of Hering & Gregory, consulting engineers, New York City, has resigned to accept an appointment as designing engineer with the Syracuse (N. Y.) Intercepting Sewer Board, of which Glenn D. Holmes is chief engineer. Mr. Cohen has been associated with Dr. Rudolph Hering for the past eight years, first with the firm of Hering & Fuller and, later, with Hering & Gregory. During this time he assisted in the preparation of reports, plans and specifications for several refuse disposal works, over thirty water supply and purification plants and more than sixty sewerage systems and sewage disposal works. His new duties will be in connection with the projected disposal works for the city of Syracuse, which will involve the design of a 50,000,000-gal. sewage pumping station, a force main about 22,000 ft. long, and a disposal plant to treat 20 to 50 million gallons daily, prior to discharge into Onondaga Lake.

## Obituary Notes

Col. Samuel D. Lehr, who served for 30 years as city engineer of Allentown, Pa., died in that city, May 19.

Charles H. Brand, president of the Atwood-Davis Sand Company, Chicago, died in that city May 22. He was graduated from Northwestern University in 1887.

Walter Moberly, who had charge of locating the route of the Canadian Pacific Railway between Great Shuswap Lake and House and Eagle passes from 1871-1878, died at Vancouver, B. C., May 15.

Edward T. Morris, manager and construction engineer for the Associated Pipe Lines in California, died in Oakland, Cal., May 14. He was born in England in 1865, and came to this country as a young man. For many years he was with the Union Iron Works of San Francisco, and superintended the construction of the battleship Oregon, the Charleston, the San Francisco and Dewey's flagship, the Olympia. He later became superintending engineer of the Oceanic Steamship Company, and was afterward made general superintendent of the Fulton Iron Works.

Alain de Pierrefeu, engineer in charge of the metallurgical and industrial division of tests of the Illinois Steel Company, South Chicago, was killed last week in France. Educated in France and in the Laurence Scientific School, he entered service in the mills of the steel company in the lowest position seven years ago. He worked up through the laboratory section until he had charge of testing all kinds of special steel and various treatments of structural steel. He was an officer of the Seventeenth Infantry and left for the war last October. Letters to Langdon Pearse state that he was wounded about two months ago and had been obliged to leave the trenches on account of eye strain. His wife, a daughter of William Tudor, of Boston, is in Red Cross work abroad, but the four children are with the grandparents in Boston.

## Civil Service Examinations

**United States.**—An examination for junior railway civil engineers, grade I and II, with salaries of from $1200 to $1680 and from $720 to $1080 respectively, will be held June 23, at the usual places throughout the country. The duties of these positions will be in connection with valuation work of the Interstate Commerce Commission. Applicants for grade I should have 4 years' experience in railway engineering and applicants for grade II, 2 years' experience. Candidates for both positions must be 21 years of age. Persons who desire to take this examination should apply at once for full information to the United States Civil Service Commission, Washington, D. C.

**Examinations Previously Announced**

| Date | See Eng. Record |
|---|---|
| June 3—Transitman, Philadelphia, salary $900 | April 24 |
| June 4—Second assistant, salary $1000; assistant engineer, salary $4000; Philadelphia | April 24 |
| June 5—Assistant railroad engineer, State of Illinois | May 8 |
| Assistant chief utilities engineer, salary from $300 to $375; railroad engineer, salary from $250 to $333.33; service engineer, salary from $200 to $300; State of Illinois | May 22 |

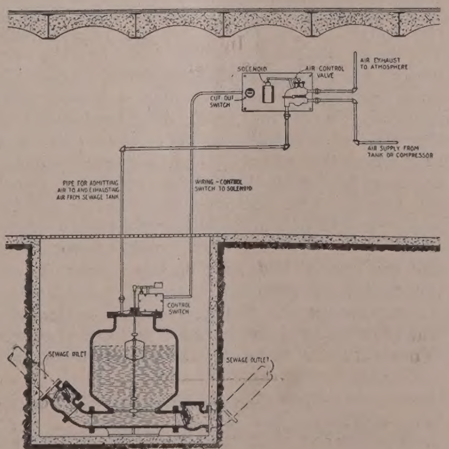
## Ceresit Exhibit at Exposition Combines Beauty with Utility

The Ceresit Water-Temple in the Palace of Machinery at the Panama-Pacific Exposition, San Francisco, is an attractive structure, demonstrating the waterproofing qualities of Ceresit waterproofing compound. There is a fountain at the pinnacle that pours a constant stream of water over the concrete dome, and thence along the eves, through the eight supporting pillars, down to the base. There are plate glass inserts in each pillar, the interior of which is lighted with concealed lights which illuminate the falling water. The temple is 16 ft. in height.

## Automatic Sewage Ejector Lifts Liquids from Low to High Level

An electrically controlled automatic sewage ejector system which is claimed by the makers to be sewage, gas and air tight, and which reduces piping connections to a minimum with a consequent saving in materials, labor and upkeep cost, is being manufactured by James Beggs & Company, 36 Warren Street, New York City. The system is designed to expel sewage automatically from buildings where natural flow and self-cleansing of drainage pipes demand that liquid accumulations be collected at a level lower than that of the sewer into which they are to be discharged. It may also be used, with or without modification, for handling any liquids that can be accumulated in tanks, and which must be lifted to higher levels.

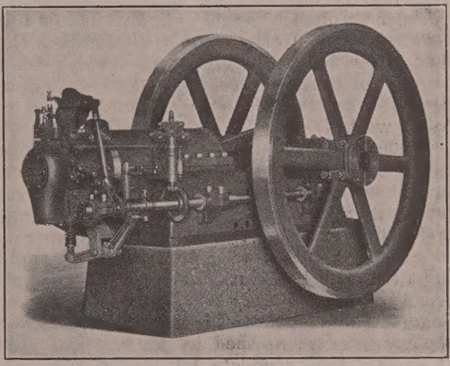
The arrangements and essentials of a complete installation, which are shown in the illustration, include a receiving tank, into which the sewage gravitates from the drain pipe and which is designed to leave a space above the sewage in which compressed air is admitted for the purpose of forcing it, by displacement, through an outlet connected with the sewer. Check valves placed in the tank outlets prevent the return of sewage into the drain pipe, and those placed in the tank outlets prevent backing up of the sewage into the tank. A special double-acting air valve, electrically controlled, automatically admits compressed air each time to displace and expel the desired amount of liquid from the tank. A supply of compressed air may be taken from a general system or may be maintained by a suitable compressor and receiver installed to serve the sewage ejector exclusively. One pipe connection between this valve and the tank described above alternately serves the purpose of an inlet to the tank for compressed air and an outlet for the exhaust of the air to the atmosphere, after the sewage has been ejected and the tank is refilling. A float, rising and falling between stops, according to the level of the sewage in the tank, automatically operates the control switch, mounted on top of the tanks. This opens and closes the electric conduit through a solenoid mounted on the same base as the air valves. The solenoid is designed for any voltage which may be required to meet local conditions. In operation the vertical rod, connecting at its top to the switch lever, passes through the float, guided near its upper end by a stuffing box in the cover of the tank and at its lower end by a suitable bearing, and is provided with two limiting stops. The float, rising with the level of the liquid, strikes the upper stops and lifts the rod, which closes the switch, completes the electric circuit to the solenoid, which through its plunger and lever closes the upper valves and admits the compressed air. Then the float, descending with the level of the sewage in the tank, strikes the lower stop, bears the rod down, opens the control switch, breaks the circuit to the solenoid, and permits the spring to close the lower valve and open the upper. This completes the cycle and the sewage then collects for the next discharging operation. It is said that the system requires practically no oiling or cleaning, and that it may be operated for a long time without any attention whatever.


SOLENOID
AIR CONTROL VALVE
AIR EXHAUST TO ATMOSPHERE
CUT OUT SWITCH
AIR SUPPLY FROM TANK OR COMPRESSOR
PIPE FOR ADMITTING AIR TO AND EXHAUSTING AIR FROM SEWAGE TANK
WIRING - CONTROL SWITCH TO SOLENOID
CONTROL SWITCH
SEWAGE INLET
SEWAGE OUTLET

AUTOMATIC SEWAGE EJECTOR SYSTEM

## Low-Pressure Oil Engine Has Positive Ignition Without Spark or Hot Tube

A crude-oil engine, igniting its charges by partial distillation of the lighter hydrocarbons of the oil in the primary cylinder, and which



ENGINE IGNITES ITS CHARGE BY PARTIAL DISTILLATION OF THE LIGHTER HYDROCARBONS OF OIL

therefore operates at a lower pressure and temperature than the Diesel engine, has been on the market during the last year, and is said to be meeting the demands of contractors and industrial service for a reliable, fool-proof and cheaply operated power plant.

The primary distillation is accomplished by the injection of air in the compression stroke of the main cylinder through a fine hole in the primary cylinder. This air, the temperature of which is raised by compression, passes through the liquid oil, and vaporizes and explodes some of the lighter hydrocarbons. This primary explosion injects the main charge into the main cylinder, which is filled with a compressed air charge at this point, at a burning temperature, and the main explosion takes place. The engine is four cycle and of horizontal design. It is claimed that the smaller sizes start cold in a few revolutions, under any temperature conditions. The larger sizes are provided with a compressor for starting. It is said that backfiring and pre-ignition cannot occur.

The fuel consumption is given at 0.6 lb. per horsepower hour, or at a cost of approximately ½ cent per horsepower hour. The cost of the engine varies according to size from $40 per horsepower down, and its weight from 350 lb. per horsepower in the 75-hp size to 250 lb. per horsepower in the smaller sizes. Concrete mixers, pumps, etc., are regularly equipped with small sizes of this engine in place of gasoline engines. It is said that these engines require no attention in this service, after being started, beyond lubrication. The larger sizes are manufactured and sold for generating electric current for lighting and industrial purposes, and it is asserted that they will doubtless come into use in the same kind of service for contractors.

A twenty-year life is claimed for the machines, owing to the absence of delicate parts and the general sturdy construction, and the repair bills are said to average, for labor and material, only 2 per cent of the first cost per year. The engines are manufactured by the Standard Scale & Supply Company, of Pittsburgh.

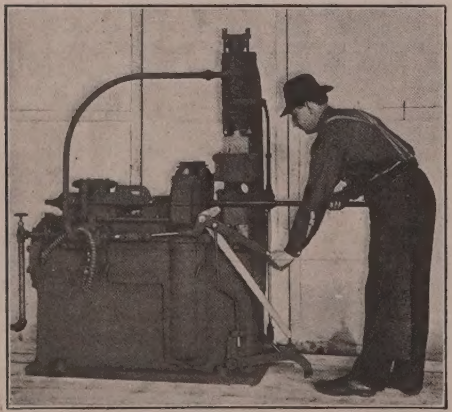
## Pneumatic Drill Sharpener Heads Bolts and Does Other Work

A new drill-sharpening machine with a horizontal hammer for upsetting the steel and a vertical hammer for finishing it has just been brought out by the Sullivan Machinery Company, of Chicago. The machine is operated with compressed air at 100 lb. pressure, and has an air vise, seen in the illustration, gripping a steel between the two hammers. The vertical hammer cannot operate while the horizontal hammer is running. The lever which opens the latter, and which is held in the operator's left hand, throws down the stop shown at the right bottom of the base, and locks the treadle which controls the vertical hammer. The horizontal hammer cannot operate until the vise has closed. The vise closes as the operating lever is depressed, and grips the steel before air is admitted to the hammer. The vise is operated by a 12-in. horizontal cylinder through a toggle link, and has an unusually powerful grip. The lever shown in the illustration below the operator's hand is used to pull out the pins inserted in hollow steel to keep the center hole open while the steel is being worked.

In sharpening new steel, the operator clamps the stock in the vise, upsets it slightly with a few blows of the horizontal hammer, then releases it, and begins to draw out the wings under the vertical hammer. This hammer is so arranged that slow heavy blows or rapid light ones can be struck. The steel is thus alternated until sufficiently upset and proper gage and angle given to the cutting edges, when the corners are finished by the vertical dies. It is said that complete bits are customarily made from blank steel in one heat in the Sullivan sharpener, and that a blacksmith can finish new bits, with a little practice, in from 50 to 60 seconds each.

Bits of any form and gage may be made on this machine from solid or hollowed steel of any shape. Dollies are also furnished for forming shanks. In addition to forging drills, bolts may be headed and other smithing work of considerable range done economically with the machine.

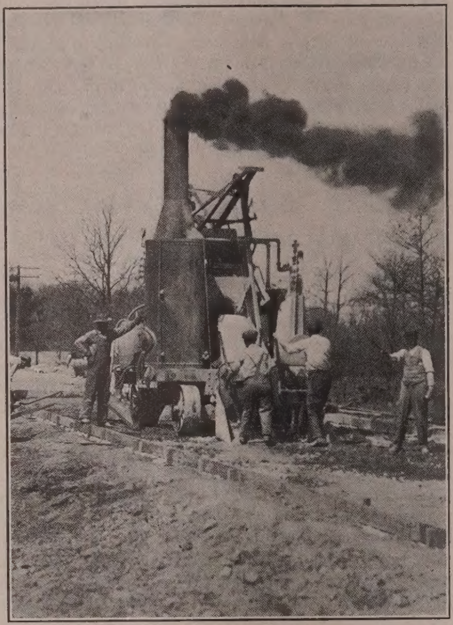
The machine is designed along the lines of the old Imperial sharpener, the right to which this company has taken over. It is, however, much larger and more powerful than the earlier machine. The new machine takes up small floor space since it is 5 x 2½ ft. in size and is 6 ft. high. It weighs approximately 4000 lb. complete.



OPERATING WITH ONE LEVER VISE AND HAMMER ON NEW DRILL SHARPENER

## Simplicity of Operation Claimed for This Paving Mixer

Simplified operation minimizing the efforts of the operator is one of the improvements claimed for the latest model Milwaukee paving mixer. By means of a screw that throws out the clutches at the proper time, the bucket is stopped automatically at the end of the boom and also when it is returned to the mixer. When the lever is thrown to raise the skip the operator does not have to give any further attention, as the skip goes to the top and stops automatically. As a result he can be working with the bucket. The skip, which is 5½ ft. wide, can be held in any position when it is desired to move the machine. Two wheelbarrows can easily dump into the skip at one time, as shown in the accompanying photograph. When it is necessary to go under low bridges the entire top of the mixer can be lowered on hinge supports, without the necessity of dismantling the machine. The engine and governor are housed to protect the machinery from dirt. The machine is built in three sizes, 10, 16 and 22 cu. ft., by the Milwaukee Concrete Mixer Company, Milwaukee.



TWO WHEELBARROWS CAN DUMP INTO SKIP AT ONE TIME

## New Front Drive, Bottom-Dump Truck Saves Tire Costs

Instead of carrying about 90 per cent of its load on the rear tires, the new bottom-dump motor truck, which has just been placed on the market by the Watson Wagon Company, of Canastota, N. Y., is provided with a front drive which allows only about 66 per cent of the weight to be placed on the rear wheels. The front wheels are rubber tired but the rear wheels are of wood with steel rims, so that the large item of tire maintenance is considerably reduced. With the front drive principle all the rear wheels have to do is carry the load, and when the wagon is dumped the load can not interfere with the driving wheels and stall the truck. The bottom-dump feature of the truck results in a low center of gravity of the load, while with the usual rear dump truck and the special body, set on top of the chassis the center of gravity is raised considerably. An advantage for the low center of gravity when traveling at high speed is claimed by the manufacturers of the bottom-dump truck.

## Business Notes

**The United States Cast Iron Pipe & Foundry Company,** with general offices at Burlington, N. J., will open an office at the R. A. Long Building, Kansas City, about June 1. R. C. Clifford, formerly of the St. Louis office of the company, will have charge of the new office.

**Robert Nesch,** president and general manager of the Pittsburgh Paving Brick Company, and also president of the Western Paving Brick Manufacturers' Association, died in Kansas City, May 19.

**Industrial Works,** manufacturers of railway cranes and pile drivers of Bay City, Mich., has established as its Pacific Coast agents, N. B. Livermore & Co., of San Francisco and Los Angeles, and the Northwestern Equipment Company, of Seattle and Portland.

## Trade Publications

The following companies have recently issued trade literature:

**Solvay Process Company,** Syracuse, N. Y. Folder, 3½ x 6¼ in., 6 pages, illustrated. Deals with Solvay stack paint, highly resistant to the effects of heat.

**Redwood Manufacturers Company,** San Francisco. Catalog 13, 6 x 9 in., 20 pages, illustrated. Describes Remco redwood tanks, and contains price lists in full of tanks from 3 to 40 ft. in diameter.

**Vulcan Engineering Sales Company,** 2059 Elston Avenue, Chicago. Catalog 3, 6 x 9 in., 64 pages, illustrated. Describes in detail Hanna type riveters for bridge and structural steel industries, as well as other special foundry machinery.

**Mead-Morrison Manufacturing Company,** East Boston, Mass. Catalog K-3, 6 x 9 in., 54 pages, illustrated. Describes in detail full line of grab buckets varying from the so-called shell-grab to orange-peel and special grab types.

**Link-Belt Company,** Chicago. Catalog 210, 6 x 9 in., 48 pages, illustrated. Describes standard and collapsible types of portable wagon and truck loaders. The claim for these machines is that they load teams at a rate of a ton per minute.

**Barber Asphalt Paving Company,** Philadelphia. Booklet, 6 x 9 in., 32 pages, illustrated. Descriptive treatise by Clifford Richardson on Trinidad and Bermudez lake asphalts, their source and production, and their uses in highway construction.

**Atlas Engineering Company,** 777 Thirteenth Street, Milwaukee. Folder, 5½ x 8½ in., 16 pages, illustrated. Embraces the general line of Atlas concrete mixers, describing them briefly and referring to catalogs which cover each specifically.

**Marion Steam Shovel Company,** Marion, Ohio. Catalog 93, 5¾ x 8¼ in., 48 pages, illustrated. Describes the uses to which Marion steam shovels may be put in contracting work and contains general specifications and facts about these shovels.

**Standard Scale & Supply Company,** 1345 Wabash Avenue, Chicago. Catalog Y-125, 6 x 9 in., 40 pages, illustrated. Deals with Standard low-charging and street-paving concrete mixers. Several special models of the former are described, as well as the fundamental features of both types.

**Sullivan Machinery Company,** 122 South Michigan Avenue, Chicago. Bulletin 66-G, second edition, 6 x 9 in., 12 pages, illustrated. Descriptive treatment of air-feed stoping drills for tunneling work. Booklet 115, 5½ x 3½ in., 32 pages, illustrated. Contains technical data of Sullivan air compressors from 6 hp to 395 hp capacities.

**Wallace & Tiernan Co., Inc.,** New York City. Booklet, 9 x 12 in., 36 pages, illustrated. Chlorine control apparatus for water and sewage purification. An unusually clear and complete description of the several types of equipment manufactured by this company. The data, apparently, have been prepared by some one thoroughly familiar with the needs of the operators of such plants.